Engineering

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STATION REMOVALS AND CHANGES.

In every business there is some item which may properly be called "dead expense"; an expense item that produces no return either in increased revenue or improved service. One of these items in the telephone business is that covered by the account numbered 607, Station Removals and Changes, in the Class A and B accounting system.

To this account is charged the cost of removing telephones upon which service is discontinued together with the original cost of labor installing and such installation materials as wire staples and miscellaneous material that can not be recovered economically. Whenever a telephone is removed there is, or should be, charged to this account an amount ranging from $2.00 upwards, depending upon the character of installation work and the wage scale of the company.

While some of the material may be recovered by reusing it on later installations, the instaling labor and the labor of removing the instrument are absolutely lost in the sense that they contribute nothing further to the plant or to the service of the subscribers who continue.

A certain amount of expense of this kind must be carried by every industry, but good management requires that it be kept down to the smallest possible amount. There are many telephone managers who, when they see the figures opposite the station removals and changes account in their monthly and annual statements, are looking for some one to show them a way of reducing the item. Perhaps some day, some one will find a way of keeping the telephones in place even with the constant moving that goes on among the subscribers.

THE ANNUAL AUDIT

As this is the time of year for closing the books and making up the statements that show the results of the year's operations, it would seem to be opportune to refer to a business practice that is not as widely observed as it deserves to be by telephone companies of small and moderate size. We refer to the practice of having an annual audit made by disinterested public accountants.

Those who have read the annual reports of the American Telephone and Telegraph Co. and of the larger Independent telephone companies are familiar with the auditor's statement which invariably accompanies the financial statements certifying that the accounts have been audited and that the statements set forth the true state of the company's operations and finances. If such a practice is good for larger companies it would seem to be good for smaller ones also.

The compass of a short editorial does not permit an extended discussion of the benefits of such an annual audit. It is sufficient to say it is an absolute necessity if securities are to be marketed through financial houses of recognized standing; it is a check on the bookkeeping of the company and upon income tax and other reports and is frequently the cause of substantial savings and many times is the source of suggestions for simplifying the accounting methods of the company.

The principal objection is that of cost, but the cost is often justified by direct financial benefits as occurred in one company which secured a refund on overpayments of federal income tax in excess of the cost of a five-year audit. Ordinarily one-tenth to one-twentieth of one percent of the gross annual income is sufficient to pay the cost.

Of course there may be the exceptional manager who objects to an audit out of fear that the report will give to his board of directors concrete evidence of inefficiency of management or disclose matters concerning which he would prefer to keep them in ignorance. The honest and efficient manager should welcome having made such a report of his stewardship and, as for the board of directors, it would seem that they are remiss in their duties to

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stockholders if they do not insist on such an examination of books and report of conditions.

SIDE LINES ON TELEPHONE MANUFACTURING.

In recent years there has been some comment among telephone operating men about the fact that manufacturers of telephone equipment have been engaging in the manufacture of other articles as "side lines." This comment seems to be occasioned in part by the fear that the side lines may become so important or so profitable that the telephone business will suffer.

While it is true that almost every maker of telephone equipment is engaged in the manufacture of other specialties which are only indirectly or not at all connected with the telephone business, a survey of the field does not give any cause for anxiety. In the first place, no one has produced any evidence that the manufacturers have, in the smallest measure, reduced their efforts to develop improved types of apparatus or their efforts to induce telephone companies to purchase more and better equipment. A little study of the advertising pages of this journal would indicate that the effort in both lines is becoming stronger rather than weaker. The stronger selling effort also is evidenced by the fact that a number of the manufacturers now have two and three men in states formerly covered by one and have their own salesmen in districts formerly served through agents or jobbers.

The future development is safeguarded by the fact that the executives of the manufacturing plants are without exception telephone men who have been connected with that industry for more years than some of the specialties have been in existence. They are surrounded by corps of engineers and experimenters whose primary interest is in the telephone art. A little acquaintance with the manufacturing organizations will soon show that the development work on the specialties is generally done by specialists in those lines rather than by the regular corps of the telephone department.

In the factory itself, the introduction of the specialties does not disorganize the telephone manufacturing as the various operations in the punch press, machine, insulating, winding, assembling and other departments are much the same. It is only in the matter of capacity of the plants that the telephone operating industry may be affected. There is ample manufacturing capacity for ordinary times with some spare capacity available for rush periods. So far as we can observe, the specialty manufacturing work has only absorbed some of this spare capacity during periods when it is not required by the telephone business.

It should be a matter of congratulation rather than criticism that the manufacturers have been able to find other lines so that their market is not entirely restricted to a single industry. In this way employment will be more steady and they can retain their workers over any dull periods that may strike that industry. Overhead expenses will be reduced because there will be less idle plant and machinery and when activity in the telephone industry requires additional manufacturing capacity, the equipment and personnel are available.

The telephone industry is fortunate in having a group of strong manufacturing plants. Most of them if not all have been accorded a fair measure of prosperity without unloading upon the industry their products at exhorbitant prices. The operating men of the industry can show their appreciation of the efforts of these manufacturers to provide a satisfactory supply of equipment and constant improvements in quality and service by continuing their patronage, by paying a fair price for what they purchase and by adopting meritorious developments whenever the worth is demonstrated.

COMING CONVENTIONS

SOUTH DAKOTA

Sioux Falls, Cataract Hotel, January 12, 13 and 14, 1926.

MINNESOTA

Minneapolis, West Hotel, January 26, 27 and 28.

NORTH DAKOTA

March 9, 10 and 11.

OKLAHOMA

Tulsa, Mayo Hotel, March 9, 10 and 11.

KANSAS

Topeka, April 6, 7 and 8.

OHIO

Columbus, New Neill House, April 21, 22 and 23.

NEW YORK

Rochester, May 19, 20 and 21.

PENNSYLVANIA

Philadelphia, during Sesquicentennial Celebration.

STUDY THE INDEX

The primary purpose of an index to a publication like Telephone Engineer is to provide a means of locating a desired article without the necessity of turning to the tables of contents of individual numbers. It is a convenience that everyone who has occasion to refer to back numbers appreciates.

We believe there is another use of the index that is not always made. If the reader will turn to the index of the 1925 volume which appears in this number and will read it over, we are sure that he will be bringing out some of the numbers of the journal for the past year for re-reading of certain articles, for reading of others which were laid aside for lack of time and for reading of some articles which did not appear to be particularly applicable then but which now have taken a new interest because something has come up that makes them timely.

"Pretty Good" Was Old Year's Treatment of Industry

Steady and consistent progress has been the mark of the year 1925 in the telephone industry. The close of the year finds every department and phase of telephone activity in a more favorable situation that at the beginning. There has been a substantial growth in the number of stations in service; plant additions have been made to keep up with the station growth; financial results have been satisfactory as a whole; an adequate supply of new capital has been available and the character of the service rendered has been improved. Some interesting by-product services have also been developed particularly in connection with the long distance lines.

Interstate Commerce Commission reports for the first nine months of the year indicate a growth at a rate of about 6% in stations in service among Class A companies. It is probable that this is approximately the figure for the entire industry. If this rate of growth is a criterion it is to be expected that about one million telephones were added to the system of the United States during the year. An outlay of in the neighborhood of $300,000,000 for new plant to care for this growth was necessary.

Industry's Financial Situation

The financial situation of the industry continues to be satisfactory. Telephone securities have come to be looked upon by the investing public as one of the most desirable types of investment. As a result, the issues that have been placed on the market have been absorbed readily and financial houses have shown a great deal of interest in securing additional issues. This has resulted in a number of offers made to owners of plant to purchase the properties with the view of effecting consolidations into larger units. While some consolidations have taken place there has been no particular interest displayed by telephone men to dispose of their properties in order to provide the financial houses with a supply of securities.

Unprecedented damage to smaller plants by the sleet storm just before the close of the preceding year brought about large needs for new money to rehabilitate the properties. In the State of Illinois particularly, many plants were almost completely wiped out. Through the efforts of the Illinois Telephone Association the situation was brought before the Commerce Commission of that state and provision was made for rate increases for the purpose of providing funds to meet the charges on the capital needed for rebuilding. As a result, a majority of the companies found little difficulty in raising the funds and it was found in most cases that this could be done locally when the company was placed on a sound financial basis as far as earnings were concerned.

Rates and Revenues

In the Independent branch of the industry the rate situation during the year was not distinguished by any large change. A number of companies which had not brought their rates up to levels required by general increases in costs, were granted increases. There are still some companies operating on low rates but these are slowly being brought into line.

Many of the Bell companies have been involved in state-wide rate investigations. In several states the companies are operating under court orders from Federal Courts permitting the collection of certain rate schedules. In other states hearing are under way while in Massachusetts, Maine and Maryland increases have been granted.

Consolidations and Elimination of Competition

A number of consolidations have taken place eliminating competitive exchanges. This activity has been greatest in Pennsylvania where there were still many duplicate exchanges. The largest individual company to be absorbed by the Bell System was the Penn State Telephone Company of Lancaster, Pa. In a number of important centers the Bell exchange was taken over by the Independent company. In a general way, the number of stations transferred to the Bell was in excess of the number released by them and this situation led to action late in the year by the directors of the United States Independent Telephone Association looking toward a more equal exchange in the number of stations. No definite agreement has been announced up to the present time but it is understood that progress has resulted from the conferences between the two interests.

Association Activities

National, State and District Associations continued their activities during the year. Probably the outstanding feature of Association activity was the holding of accounting conferences in various parts of the country by the Accounting Committees and Officers of the United States Independent Telephone Association were represented at these meetings. Statistical data showing the operating results of the various companies were presented and much attention was paid to accounting practice with a view of establishing more uniform methods. A list of units to be handled through the capital accounts in order that a definite line might be drawn between maintenance and depreciation was discussed at the meetings and the list was finally adopted as recommended practice by the National Association at its convention in October.

The activities of the Illinois Association in the sleet storm territory has been mentioned. This association has also taken the lead in adding to its staff a transmission engineer who spends his time in the service of member of companies. Other state associations have continued and expanded the work among the companies in their respective jurisdictions.

Technical Advances

The outstanding technical achievement of the year was the completion of the New York-Chicago toll cable. This cable provides circuits for long distance service between New York and Chicago and the various important centers between those two cities. The total length of the cable is approximately 860 miles. The cable will provide 250 telephone circuits and also will reduce the interruptions to service due to storms.

The increase in toll facilities available has brought about a marked reduction in the time required to complete a long distance call between New York and Chicago and the service is now being given in an average time of less than five minutes. A portion of this reduction in time has been made possible by improved methods of signalling and switching control. Low frequency signalling is being superseded by voice frequency signalling on long lines with many repeaters in tandem.

The long distance system of the North American continent was expanded by the completion of a link which brings the Province of Alberta, Canada, into connection with the long distance system of the United States.

Commercial Transmission of Photographs

During the year commercial transmission of photographs has become a regular service between certain cities and will be extended to others as rapidly as prac-

ticable. Many new uses have been found such as the transmission of signatures and other written and printed documents as well as photographs. It is expected, however, that the transmission of news photographs will be the largest service that will be required.

Relations Between Telephone and Radio

Closer connection between telephone lines and radio broadcasting stations were established and by the end of the year it was a nightly occurrance to have from six to twenty radio stations connected over long distance lines and broadcasting the same program simultaneously.

A number of telephone companies have been able to install a leased wire service reception. A central receiving station with amplifiers is established and connections made to loud speakers in the homes of subscribers. A charge is made for the use of the telephone circuits and revenue is thus developed from what would otherwise be idle plant.

There has been an increased use of carrier current telephony on power lines and two important problems have been solved during the year. One of these is the provision of repeaters for such systems and the other is the development of a means of by-passing disconnect switches and transformer banks. These improvements will undoubtedly hasten the development of this phase of electrical communication.

Telegraph Development

During the year a new submarine telegraph cable was installed between the United States and the Azores Islands which will later become a link in direct cable connections with Germany and Italy. This cable is of the permalloy continously loaded type and permits very much increased speed of signalling more than doubling the capacity of the cable as compared to other cables.

New systems of telegraphy have also been developed for use on long telephone cable conductors. These systems are for particular application to the circuits of the New York-Chicago cable but will be extended to other cables as fast as required.

Houck McHenry Again Made Chief of Missourians at Annual Meeting

Kansas City, Mo.—Houck McHenry of Jefferson City, who has been president of the Missouri Telephone Assn. continuously since 1913, was again returned to his perennial office at the successful annual convention held here.

Accounting took one of the prominent places in the spotlight. V. E. Chaney, assistant to vice-president, Theodore Gary & Co., spoke on "Accounting for Small Companies" and outlined the standard practice the smaller companies would find most practical. President F. B. MacKinnon of the national Independent association talked of the progress being made in the association's plan for developing uniform accounting practices.

"Transmission Problems and Maintenance," the subject of the address made by V. P. Ettinger of the Southwestern Bell, presented a number of interesting charts showing the losses in outside plant and central office equipment which were analyzed in an illuminating manner. Mr. Ettinger also went into the matter of testing in detail, and in general put forth a survey of his subject that proved highly instructive.

Miss Anne Barnes of the traffic division of the national association told of the different classifications of "central." Miss Barnes in staging the first traffic conference held by the Missouri association aroused an interest in traffic conferences that undoubtedly will result in a continuance of this feature.

That most of the complaints concerning the telephone industry that came to the commissions are the result of unsatisfactory service and not of rates, was the opinion expressed by Thomas J. Brown, chairman of the Missouri Public Service Commission. Mr. Brown advocated "horse-sense," courtesy and education as the three simple factors in getting a square deal from the public for the utilities. Another prominent state official, Secretary of State Charles U. Becker, spoke before the convention. Mr. Becker, speaking on "The Capital and the Telephone Companies," stressed fair taxation as a foundation of corporation satisfaction with state government. James McQueeney, secretary of the Loose-Wiles Biscuit Co., advised the telephone men to restore the suspended workmen's compensation law to the Missouri statute books.

Radio service from telephone companies again proved a feature of a state convention program when L. W. Shearer of Yale, Okla., told the Missouri men how his company sells radio service for $1 to $2.50 a month, with the patron buying the loud speaker. Mr. Shearer said the service made use of idle plant facilities.

A number of distinguished visitors from Texas, Oklahoma, Iowa and Kansas sectors of the Independent industry and a comprehensive showing of the latest ideas in telephone equipment and supplies added to the life and profit of the meeting.

What Florida Boom Means to Telephone Business

Tampa, Fla.—There are so many more people in Tampa, with so much more to talk about that the Peninsular Telephone Company has to spend $2,500,000 and install equipment to serve 9,000 additional telephones, or an increase of practically 50 percent over the present system.

The Florida boom is also keeping the Southern Bell Telephone Co. busy. This subsidiary of the American Bell Telephone Co. will spend $2,500,000 in the Miami district next year. The Miami exchange is handling 100,000 calls every day, as against 60,000 a year ago, with 128 operators, as compared with 28 a year ago. In planning extension the company forecasts that Miami by 1928 will have as many telephones as New Orleans. It has more than 16,000 now. The number will be more than 110,000 by 1940, according to this forecast.

Minnesota's Convention Jan. 26-28, West Hotel, Minneapolis

Minneapolis, Minn.—Secretary J. C. Crowley, Jr., and other officials of the Minnesota Telephone Assn. are planning a lively practical program for the annual convention of the association, which will be held at West Hotel, Minneapolis, January 26-28. The association expects a record attendance.

Wood Preservers to Meet at Cleveland, Jan. 26-28

Cleveland, O.—Twenty-second annual meeting of the American Wood-Preservers Assn. will be held here at the Cleveland Hotel, January 26-28. S. D. Cooper, president of the association, and E. J. Stocking, secretary, are completing plans for some intensely practical and valuable sessions.

Northern White Cedar in 30th Meet; Minneapolis, Jan. 25-26

Minneapolis, Minn.—Thirtieth annual meeting of the Northern White Cedar Association will be held here Monday and Tuesday, January 25 and 26. Norman E. Boucher, Lumber Exchange Bldg., Minneapolis, is secretary of the association.

Texas Meets at Fort Worth, March 16-18

Fort Worth, Tex.—Texas Independent Telephone Assn. will hold its 21st annual convention at the Texas Hotel here, March 16-18. Details of the convention are being prepared by President R. B. Still and the other officers of the organization.

Night Material Loading for Speed and Thrift

By JOHN SULLIVAN

The question of getting material and man power together is always a foremost one in the minds of telephone plant officials. How many of us have seen a couple of hundred men milling around a telephone storeroom and garage waiting for their foremen and drivers or trying to beg, borrow or steal material so that they could begin their day's work.

The development of an orderly system of handling material to avoid loss of time of installers and construction men and of automotive equipment is difficult enough in any place, but a particularly knotty problem was found in a large exchange area after the operation of two competing properties had been unified. One of the properties was a manual exchange area with both local and common battery service and the other was largely automatic with both 2-wire and 3-wire equipment. Taking into account the situation that both manual and automatic equipment of wall and desk type were in use, that the area included both common battery and local battery offices and that party line development required the use of subscriber sets with different types of ringers, it may be seen that a very large number of types of equipment were required. It was no small job to see that the right type of apparatus was at hand to install the particular order upon which a man was working.

After going over the ground, including both stockroom and construction force needs and looking at it particularly from the installation viewpoint, it was apparent that the plan of getting out the material to the crews in the morning would always result in much confusion. This could be eliminated by the adoption of a night loading plan which was feasible in this particular case, since the garage and store room were adjacent.

Standard Packages of Material Used

To make the night loading plan effective, however, it was necessary to do more advance planning of the work and to make some special arrangements in the store room. One of the first steps was to adopt a "standard package" method of wrapping station installation material. Under this plan a group of material needed for the installation is assembled and wrapped in the warehouse so that it can be issued as a unit. A number was assigned to each type of standard package so that they are handled and issued entirely by package number. The following are some of the typical standard packages adopted, only the major items being listed:

Standard package No.		Contents of each package. (Major items only.)	Credit classification.
12	1	No. 60815-A 2-wire subscribers' wall set	122-11
	1	No. 58-AP protector	122-11
16	1	No. 40435 2-wire c. b. subscribers' set	122-11
	1	No. 40566 2-wire c. b. desk stand	122-11
	1	No. 58-AP protector	122-11
32	1	No. 317-N subscriber set	122-11
	1	No. 92 2½' cord	118R
	1	No. 58-AP protector	122-11
	3	dry cells	628-01
50	1	No. 534-A subscriber set	122-11
	1	No. 40-AL (or No. 20-AL) desk stand with	122-11
	1	No. 450 cord	122-11
	1	No. 58-AP protector	122-11

If the letter "X" precedes the standard package number it indicates that the package does not contain the protector. It was found to be necessary to provide 74 types of standard package to meet all the needs of the area served from the stockroom.

The next step is to get the information to the stockroom force as to what material is required and to whom it is to be delivered. This is done in the office of the Installation Supervisor. As each commercial order passes through his office, the installation copy is marked on the face with the number of the standard package required and, when required, such extra material as keys, extra desk stands, etc., except wire and miscellaneous minor materials, and also is marked with the name of the workman or the number of the truck that is to be furnished with the material.

After the order is marked it is forwarded to the stockman for the delivery of the package to the specified workman or truck. When the material is delivered it is reported on a form known as "Storeroom Material Disbursement Report." Standard stocks of wire are carried on each truck and this stock is replenished by the stockman at the time the standard packages are loaded onto the truck and the amount delivered is reported on the material disbursement report. When wire is delivered to individual workmen it is receipted for by the workman.

Workman's Only Report Is on the Order

When the workman makes the installation he records on the back of the order the standard package number and any other major material used. If material is recovered, it is also reported under standard codes on the back of the order. This is the only report of apparatus or material used that is required of the workman.

Apparatus recovered is returned to the storeroom accompanied by a tag on which is shown the date of recovery, order number and the code number on which it is recovered. The stock man checks the material against the commercial order and enters the amounts and types on a form "Storeroom Material Recovery Report." If line or drop wire is removed and junked it is also reported on the tag and on the back of the commercial order and entries are made on the same form in special space provided.

Inside wire, drop wire and bridle wire are originally charged to 28C, 23C and 48C, respectively, and are not reported unless used on other codes, in which case the code is shown on the back of the commercial order. Apparatus recovered and reused is also reported on the back of the commercial order. These entries are recorded in the office of the Installation Supervisor on a form "Report of Material Exceptions and Reused Recovered Station Apparatus."

The stockroom forms and the report of material exceptions and reused equipment are transmitted daily for the approval of the Installation Supervisor and are then forwarded to the Plant Accounting Department where they are checked and posted to the general forms for Material Used and for Material Recovered and Plant Displaced.

Night Loading of Construction Trucks

In the case of the outside plant construction forces the system is varied to meet the different conditions. The construction foreman makes out a special form showing type and amount of material needed for the next day's work. These forms are placed in a pocket of the seat of the truck. A force of two stockmen working from 4:30 to 5:30 complete all of the work necessary to provide the material for the trucks. The next morning the truck driver checks his material "want sheets," signs them and turns them in to his foreman, who turns them over to the clerical forces for the proper accounting of material. At the end of the day the construction foreman makes out a recovery slip for material on the truck which is not needed, such as junk terminals, cable, etc. This form is also turned over to the clerical force. Local conditions will

of course govern the makeup of the loading units.

Summarizing the plan of handling material, it may be said that it consists of advance specification of material needed on the job, preparation of standard packages of installation material and night loading of trucks so that the truck is ready to proceed to the work as soon as the men report in the morning.

The results obtained have been a large saving in working labor hours due to the fact that men and material are got onto the job without delay. It reduces the clerical work done by the field forces to the minimum and this has met with approval of the men themselves. Best of all, the men begin the day in a satisfied frame of mind and this has resulted in higher morale all along the line.

Bell to Spend $28,000,000 in 1926 Construction

The 1926 construction program of the Long Lines Department, American Telephone and Telegraph Co., contemplates plant construction to cost more than $28,000,000. Plant costing approximately $19,000,000 was constructed in 1925.

The proposed expenditures for 1926 are divided as follow:

Aerial wire, including new pole lines	$ 5,160,000
Long distance cables with associated pole lines, loading coils, buildings and equipment	11,200,000
Switchboards and other telephone and telegraph equipment	8,130,000
Line work not included in the aerial wire and cable projects	3,860,000

The new facilities will provide for increases in long distance telephone traffic and also will make it possible to furnish more dependable and faster service.

Long distance cable, it will be noted, is the largest single project of the construction program. The completion of the last link of all-cable route between New York and Chicago, with cable work in other sections of the country in 1925, involved the placing of about 450 miles of long distance cable during that year. The plans for 1926 include placing more than 700 miles of this type of cable. The more important cable projects in the 1926 program are:

Completion of the Chicago–St. Louis cable, already in service between Peoria and St. Louis.

On the New York–Buffalo–Cleveland cable project, completion of the Schenectady–Syracuse section and major portions of the Syracuse–Rochester and Buffalo–Dunkirk sections.

Richmond–Petersburg section of the Washington–Atlanta cable.

Momence–Watseka (Ill.) section of the Chicago–Terre Haute cable.

Additional cables on existing cable routes between Providence and Boston, New York and Philadelphia, Philadelphia and Harrisburg and Ligonier and Pittsburgh.

The 1926 construction program covers additions to the plant in nearly every state. The expenditure will amount to approximately 50 per cent more than in 1925, in which year the plant expenditures were the largest on record.

Neill and Mattison, State Chiefs, Die at Year's End

D. M. Neill of Red Wing, Minn., president of the Minnesota Telephone Assn., and Raymond E. Mattison of Lincoln, Neb., president of the Nebraska Telephone Assn., two of the leaders of the Independent Field, passed to their rewards as the old year was fading out.

Mr. Neill fell dead, December 23, as he was shoveling snow in front of his residence at Red Wing. His 74 years had been rich in achievement and in service to his family, his fellow men and his industry. A week prior to his death he had attended the ceremonies at St. Paul attendant upon the installation of the Tri-State's 100,000th telephone. For the past two years he had been president of the Minnesota association.

Mr. Neill was born in Scotland, coming to Portage, Wis., where he attended school until his entry into the drug business. He later was engaged in the lumber business in the Dakotas and came to Red Wing in 1886 to become superintendent of the Red Wing Mfg. Co. In 1904 he was an organizer of the Red Wing Telephone Co., which was sold in 1923 to the Tri-State. From 1910 to 1917 Mr. Neill was commercial superintendent for the Tri-State beside directing operations at Red Wing. In May of this year a number of the Tri-State and Minnesota association men and their wives celebrated the Neills' fiftieth wedding anniversary at Red Wing.

Mr. Neill was active in national association and Independent Pioneer affairs, as well as in the affairs of commercial and social bodies of his home city. He is survived by his widow, a daughter and two sons.

Mr. Mattison was general manager of the Lincoln T. and T. Co., as well as president of the Nebraska association at the time of his death on Christmas. He was 48 at the time of his death, and had been in poor health for some months. Mr. Mattison, a native of Ohio, entered the telephone business in 1904 with the Cuyahoga Telephone Co. at Cleveland, leaving that organization to go to Lincoln as contract agent.

When the Independent-Bell contest was waxing hot in Nebraska Mr. Mattison was directing head of the Independent group organization. In 1909 he went to Omaha to manage the Independent exchange started there and remained at that post until the famous Bell-Independent truce was signed. He then returned to Lincoln as commercial superintendent. He was a vigorous and valuable factor in the upbuilding of the Lincoln property. He was president and director of the Platte County Telephone Co. and director of the Crete Co., in addition to holding his responsible position with the Lincoln organization, at the time of his death.

Mr. Mattison was highly regarded throughout the Independent field as one of its most capable and warmly admired executives. He held a high place in the Independent national councils, being a member of the U. S. I. T. A. executive committee.

One of Mr. Mattison's sons, R. E. Mattison, Jr., is connected with the Lincoln company.

Mr. Mattison is survived by a widow, three sons, his father, and three sisters. Interment was at Saline, Mich., beside his mother.

The closing weeks of the year took heavy toll from the Independent ranks for, in addition to Messrs. Neill and Mattison, the industry lost by death E. D. Boynton, president of the Boynton Telephone Co., Pleasant Plains, Ill.; H. I. Wilson, treasurer of the Interstate Utilities Co., Spokane, Wash.; Roy L. Fox, owner of the Warrod (Minn.) Telephone Co., and John C. Thorne, president of the Fairfield (Ia.) Telephone Co.

Arthur V. Overshiner, vice president and general manager of the Scoville Mercantile Co., Atlanta, Ga., also passed along during the latter part of the year. Mr. Overshiner was one of the Independent pioneers, having started an exchange in Indiana in 1893. He then went with his brother, E. B., in the Swedish-American Telephone Co. and figured conspicuously in its growth. Later he was associated with Garford and with Stromberg-Carlson. In his work with Scoville he retained his interest in the telephone industry as the Scoville company handles the Stromberg-Carlson line.

Pioneer Hoosier Telephone Man Passes

Greencastle, Md.—Frank G. Gilmore, co-organizer of the Greencastle (Ind.) Telephone Company in 1895, died at his home there on Dec. 31, 1925, of heart disease. Mr. Gilmore was actively connected with the company for many years, retiring only a few years ago. During his active career he developed a wide acquaintance among telephone men of the state.

Unit Line Arrangement in Central Office

By JOHN M. HEATH,
(Lt., Signal Corps, U. S. Army)

PART 3

The Unit Line in the Central Office

25. *The Unit Line.*

The object of this article is to present the characteristics of one subscriber line, "The Unit Line," from the subscriber's premises to the switchboard in the central office.

In Part 2, on outside plant, we left the unit line terminating on the distributing frame in the terminal room of the central office. That, of course, is where it is taken up in this section. In this connection refer to Fig. 20. The circuiting shown in this figure is identical with the right hand one-third of Fig. 1 (see TELEPHONE ENGINEER, Aug. 1925, p. 24) and is taken as typical although it may be subjected to variations of arrangement.

The office distributing cable rises from the cable vault under the terminal room, up to the arrester side of the distributing frame, where each underground cable pair is formed out on to one single arrester as in Fig. 22.

26. *Distributing Frames—General.*

Distributing frames are of two types "A" and "B." A type "A" frame is divided into main and intermediate frames. The main frame carries the arrester and the two-point terminal blocks. The intermediate frame carries the three and four-point terminal blocks.

A type "B" frame is only one frame with arresters and four-point terminal blocks on one side and three-point terminal blocks on the other. The arresters are always mounted vertically on both types and on the type "B" the four-point terminal blocks are also mounted vertically, as they are on the same side of the frame as the arresters.

Type "A" frames are used in offices of more than 3000 lines, and type "B" frames are used in offices of 3000 or less. For the purpose of clarity, the type "B" will be used in this narrative assuming an office of 3000 lines.

The distributing frame is the junction point of all outside and inside cable, the latter being cable from the switchboard and relays. In the early days of telephone work the distributing frame was known as the junction frame, but as the art progressed and the frame began to be used for flexibility as well as a junction, it became known as a distributing frame.

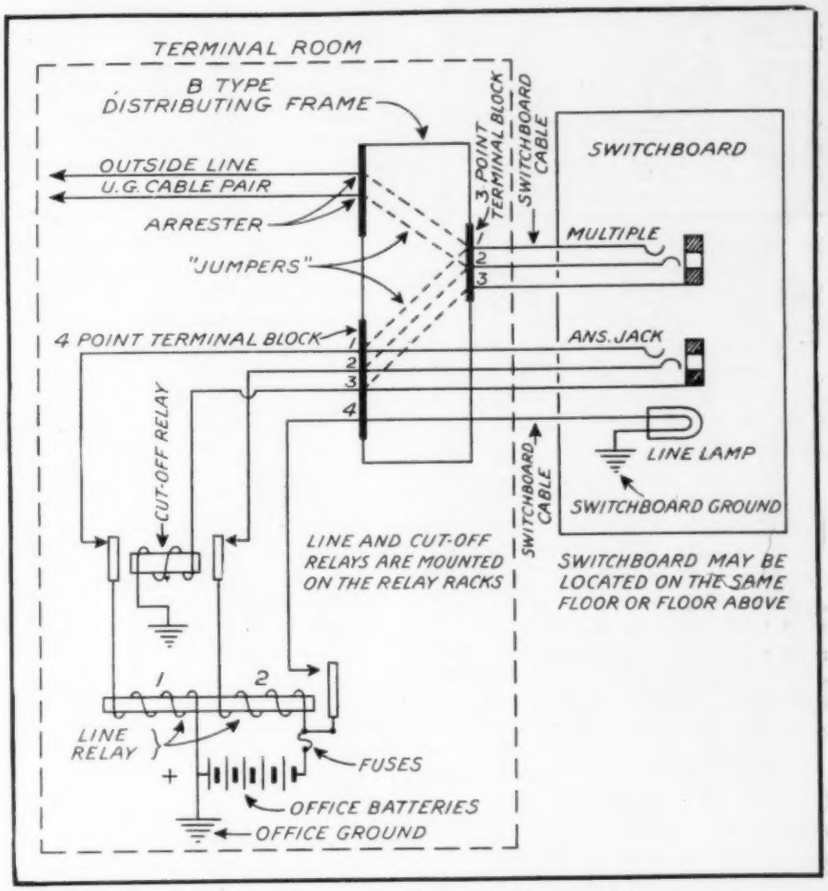


Fig. 20.—Diagram showing layout of unit line in the terminal room and one the switchboard using "B" type distributing frame.

Assuming that we have an office serving 3000 subscribers, then there would be:

3000 outside cable pair.

3000 sets of multiple.

3000 answering jacks (with lamps).

3000 line relays.

3000 cut-off relays.

and each one would be connected by one or more wires through the distributing frame. See Fig. 30 for the unit line.

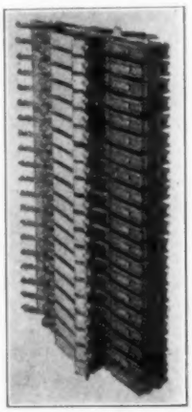


Fig. 21.—Bank of 20 arresters.

27. *Flexibility Afforded by Distributing Frames.*

In addition to the frame being merely a junction point, it also affords flexibility, i. e., any cable pair can be connected to any multiple, any multiple can be connected to any answering jack and any answering jack to any cable pair. The one thing that is fixed about a distributing frame is the association of the answering jacks with definite and unchangeable line and cut-off relays.

Notice in Fig. 20 that the wires from the answering jacks, even though they pass through the frame, continue on in unbroken lines to the line and cut-off relays, but this unbroken line is tapped at the distributing frame by means of a three-conductor jumper, and it is this jumper that forms the connection between the multiple and answering equipment.

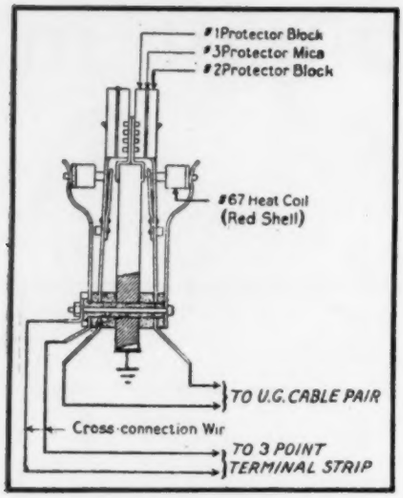


Fig. 22.—One single arrester and connections.

28. *Distributing Frames—The Arrester Side.*

Referring again to Fig. 20 on the arrester side of the distributing frame there are 3000 arresters, like the one shown in Fig. 22. These arresters are made up in strips of twenty, (Fig. 21) and the strips are bolted onto an iron upright, which is connected to ground. The number of strips that are bolted onto the upright depends largely on the height of the ceiling in the particular terminal room, but there are usually not less than ten, making 200 arresters in each verticle, this means that each verticle of a frame would serve 200 pairs coming from the underground cable.

29. *Arrester Characteristics.*

Each arrester (Fig. 22), is fitted with two No. 1 protector blocks, two No. 2 protector blocks, two No. 3 micas and two No. 67 heat coils (Western Electric Co. code). The operation of the protector is as described in paragraph 8, part 1. The heat coils are to protect the central office equipment against sneak currents. A sneak current is a current not on sufficiently high voltage to discharge across an air gap and fuse

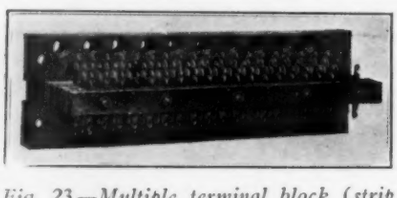


Fig. 23.—Multiple terminal block (strip of 20 sets of contacts).

the carbons, but one of sufficient voltage and current to burn and damage the delicate contacts of the central office equipment.

A heat coil is constructed as follows: A pin inserted through a small sleeve, the pin and sleeve are soldered by means of easy melting solder, around the sleeve are several turns of fine wire which form the circuit. A sneak current, in passing through the spirals of fine wire, causes it to heat sufficiently to melt the solder that is holding the pin in the sleeve, the pin now becomes free and due to pressure on it by a heavy spring, is pushed through the sleeve to the heavy iron bar in the center, thus grounding the outside conductor.

Approximate resistance of No. 67 heat coil—2.8 ohms. It will operate in 210 seconds (3½ minutes) on .54 amperes.

The unit line (Fig. 20), occupies one arrester shown by Fig. 22 on the verticle side of the distributing frame.

30. *Distributing Frames—The Multiple Terminal Block.*

To the horizontal side of the distributing frame are attached the multiple or three-point terminal blocks.

There are row upon row of these blocks, they are made up in strips of twenty each (see Fig. 23). The first

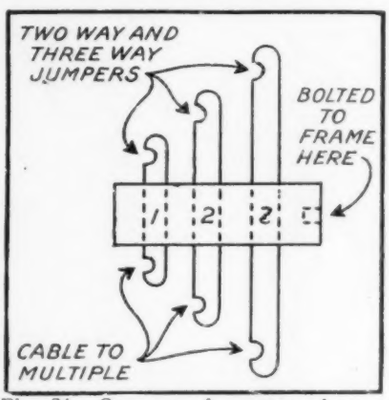


Fig. 24.—One set of contacts from a multiple terminal block.

one numbering from 0 to 19, the second from 20 to 39 and so on to 99, the additional numbers above 99 are painted on by the equipment force, when the equipment is installed, for instance, say a telephone is numbered 2019, the equipment installers would paint 2000-2099 on the row of strips serving this hundred telephones.

The cable from the multiple of the switchboard is brought up to the lower contacts (Fig. 24), of these terminals and the two-conductor and three-conductor jumpers are both soldered to the upper points. This is the point where the third wire (sleeve) is added to the line.

The unit line (Fig. 20), occupies one set of contacts as shown by Fig. 23 on the horizontal side of the distributing frame.

31. *Distributing Frames—The Answering Jack Terminal Block.*

The answering jack terminal block or four-point terminal block is mounted on the type "B" frame on the same side of the frame as the arrester and in a vertical position.

The physical construction of these terminals is shown by Fig. 25.

These are numbered 0 to 19, 20 to 39, etc., but do not run consecutively from 0 to the capacity of the switchboard, as is the case with the multiple terminal blocks. Answering jacks are defined by the panel number on the switchboard

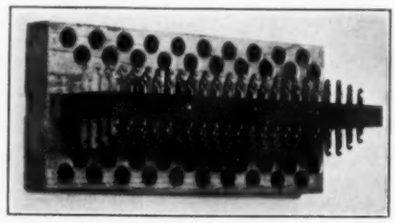


Fig. 25.—Answering jack terminal block (strip of 20 sets of contacts.)

and the number of jacks placed on each panel is determined by the number an operator can answer. Each operator's position consists of from two to two and one-half panels and if a panel consisted of sixty jacks, the jacks would be numbered 0 to 59 in each panel. An answering jack is always designated by its panel and jack number. This applies also to the terminals in the four-point terminal strip.

The four-point terminal is the junction of the cable from the answering jack, the relays, and three-conductor jumper (Fig. 20).

The cable from the answering jack meets the cable from the cut-off relay on the lower points (Fig. 26), and is permanently soldered on contacts one, two and three. Battery for the line-lamp and line-lamp wire are soldered onto the 4th contact.

The three-conductor jumper is soldered onto the upper end of contacts one, two and three and the upper end of the fourth contact is left vacant.

The unit line (Fig. 20), occupies one set of contacts as shown by Fig. 25, on the four-point terminal block on the vertical side of a distributing frame.

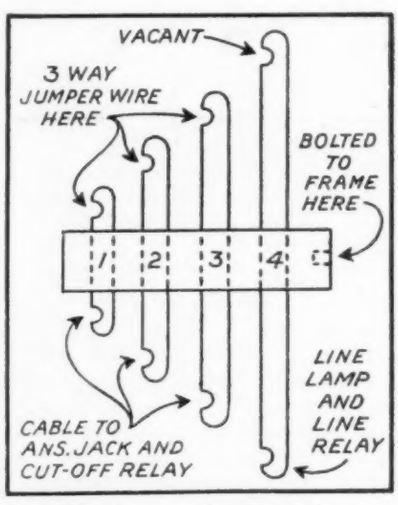


Fig. 26.—One set of contacts from an answering jack terminal block.

Bettering Rural Service at Lower Cost

By E. R. COLLINS
(*Toll Wire Chief, Manitoba Telephone System*)

The cost of giving telephone service to rural districts is one that has been a source of worry to many telephone executives. There are certain factors entering this class of service which of necessity make relatively high cost per subscriber. Grouping of subscribers on party lines seem to be the only feasible method, so far developed, to handle this class of business.

Some of the well known factors governing the cost of rural service are:

1. Distance between subscribers and resultant cost of pole line construction per subscriber.
2. Gradual decay of the outside plant.
3. Cost of transmitter battery renewals.
4. Cost of making minor line and subset repairs.
5. Cost of operation or switching charges.
6. Unusual damage caused by electrical or wind storms.

The construction of a rural system should be planned so that the subscribers on one line are grouped within the same geographical area, insofar as conditions will permit. In certain densely settled districts such as fruit farms, or truck garden, ideal conditions are met with. The writer has one locality in mind where the development was so dense that cable construction was possible for several miles to serve the farming community. Such cases are few, however, and it is the average development which concerns us most.

Poles used in rural development are of comparatively short life, depending on the nature of the soil in which they are erected. The life of poles will vary from six to 20 years, depending on local conditions. Rotting of poles can be prevented for a long time by treating the poles with creosote. This method is becoming more general with new poles. For existing pole lines resetting can be resorted to where clearance can be obtained. Long poles at road crossings and railway crossings can be saved for some time, by setting a stub on one side of the old pole and bolting or banding them to the old pole.

Dry Cell Renewals

The renewal of dry cells where made annually or semi-annually, is a large expense. This can be avoided by using a common battery type of telephone. Where this is done it is true the cost of battery renewals is eliminated, but an extra burden is imposed, that is tree trimming. Where common battery is used the line insulation must of necessity be high to provide reliable line and supervisory signals. This will in turn give better voice current transmission, which, after all, should be the aim of all operating companies.

Some companies require the subscribers to supply and change their own batteries. This practice is not all that could be desired as some subscribers are sure to be dilatory in making renewals. This arrangement is usually made by mutual companies having connection with the exchange of some other company.

A farmer on one such line came into the exchange one day and we naturally commenced talking about telephone service. The conversation drifted to changing batteries, and how long they would last. This farmer said the batteries of his telephone had not been changed for over four years, and were still good. "Why," we said, "your telephone is the cheapest thing you have on your place." "No, by gum," said he, "my old woman has been with me for over twenty years and she ain't cost me a durn cent." We gave up.

Then it is sometimes the practice to have the subscriber call at the exchange for new batteries. Where this is done it is a good plan to have the store keeper or the one handing out the batteries tie them together and put on the jumpers. This will be a good guard against connecting them incorrectly. The subscriber should be required to sign a receipt for the batteries and to call the test desk or chief operator when they have been changed. An accurate record of each telephone should be kept, showing battery renewals. This is to prevent subscribers from using batteries for some other appliance other than the telephone.

Some Renewal Line Troubles Are Hard to Find

Rural troubles can be placed in two classes, namely, line and substation troubles. Line troubles can be placed in six classes:

1. Broken insulators.
2. Slack wires in lead, wires broken by frost.
3. Broken poles or cross arms.
4. Trees growing up through the lines.
5. Poor joints in line wire.
6. Poor connection between line and drop wires.

Troubles of the first four classes can be easily seen during a patrol of the line. The trouble man should make it his business to have all necessary material with him to attend to all such repairs. Work which might require considerable time to do should be reported to the wire chief or officer in charge. This report should be in writing. It is too often the case that a trouble man will say "Some other time will do" and let a trouble pass.

Poor joints in the line wire cannot often be detected from the ground, but are easiest found by appropriate tests which we will cover in another article. Connections between the line and drop wires can only be found by climbing the tall timbers and having a look. All connections between iron and copper should be carefully soldered or secured with a good test connector. All such connections should be inspected at least once a year. The time required to do this is small but the results attained are big, very big.

Twisted or hand joints in the iron line wire should be removed and replaced with a good sleeve connector. But remember that unless a sleeve connector is twisted the full 3½ turns, the effect of such a connection is liable to be far worse than an ordinary hand joint. The writer cut out one joint made with a steel sleeve, twisted only two turns, which measured 450 ohms with the Wheatstone Bridge. The difference in the work required to make a good joint compared with a carelessly made joint is very small, but it might cost a good many round dollars to find and remove a joint that could have been made perfect at the cost of a very few cents extra time.

Substation Troubles Are Various and Costly

Substation troubles can be grouped into five classes:

1. Dry cell renewals.
2. Cord renewals.
3. Generator or ringer troubles, hook

switch and push button troubles.

4. Inside, drop and ground wire troubles.

5. Protector troubles, including grounds at protector carbons.

It is with the last class of trouble I wish to deal. This class of trouble is very prevalent and costly. Whenever I see a trouble report all filled up with reports of "Grounded in substation carbons," I think of a dog chasing his tail. The dog runs around frantically in a circle, gets nowhere, and very seldom succeeds in catching his tail.

The troubleman who chases around all summer clearing grounded carbons in substation protectors, after thunder storms, works hard, covers a lot of ground, runs up a big livery and board bill and the telephone company is paying for his time. It is true that he clears the trouble and sometimes several times in the one season does he clear the same troubles on the same lines. In addition to the expense involved, there is the out of service time of the lines affected. There is also this phase of the question: The time that such trouble occurs is in the good old summer time, which is the best time to make general repairs to the rural plant. If this nuisance is eliminated the troubleman is free to do some useful work during ideal weather.

Where the ordinary type of air gap arrester, using either carbon or copper blocks, is used, grounding is very prevalent during electrical storms. However, there are protectors on the market employing a carbon block for the ground plate and two saw-tooth brass plates connected to the line wires. The air gap between the carbon and brass plates is 1/100 of an inch. These protectors do protect the system, but will not cause a permanent ground on the line to which they are connected. As evidence of this we submit some statistics which give some interesting data on this phase of rural line operation as well as other features.

We are operating a rural system in connection with an automatic exchange of the Strowger type. This rural system covers an area with a 30 mile radius. Some of the lines are 35 miles in total length. About four years ago we changed all the instruments, installing a magneto telephone equipped with a standard dial or calling device. The lines are operated as straight magneto line for calls from one subscriber to another on the same line, using a code ring. The dial is used for calling numbers on the city system, using four digits for each number. The dial is also used to call subscribers on other rural lines using five digits. The first three digits select the line and the last two digits the code ring. The ringing is automatic and repeats till the called

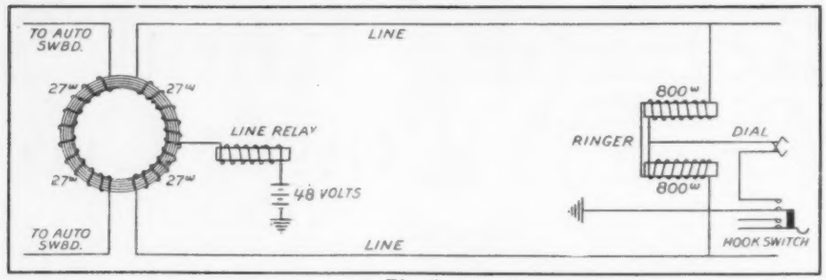


Fig. 1.

subscriber answers or the calling subscriber hangs up his receiver. We will not attempt to describe the apparatus used in making such automatic connections, other than outline the scheme of line circuit used.

Referring to sketch No. 1 it will be noticed that battery is fed through the line relay of the automatic switch, through the two windings of the repeating coil, over both line wires through the ringer coils to the center point, through the dial contacts and hook switch contacts to ground. This forms a simplex circuit, depending on the ground return.

The line relays are adjusted to work through 1100 ohms of a series of resistences, and to operate with a leak to ground of 7000 ohms. This adjustment gives ample margin for reliable operation of the switch all over lines operation of the switch over all lines. We make a practice of testing the rural line switches every day to offset any serious change in line conditions which may arise.

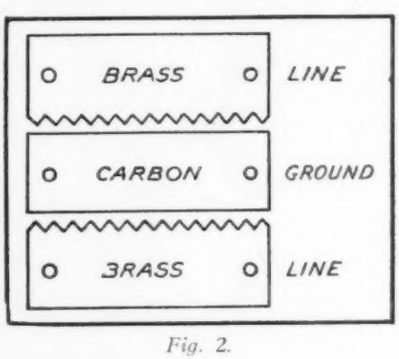


Fig. 2.

At the time the telephones were changed we installed a new type of protector. Since there is no high tension exposure there are no fuses installed at a substation. The protector is equipped with the carbon and brass plates mentioned previously. These are quite similar in operation to the old saw-tooth arresters used some years ago. (See Figure 2.)

Substation Ground Resistance Is Frequently High

To operate the automatic switches satisfactorily the joint resistance of the ringers, line wires, repeating coils, and the series resistance of the line relay which is 250 ohms, and the resistance of the ground must be below 1100 ohms. In quite a number of cases we found the resistance of the substation ground to be quite high. These were overcome by driving a longer rod, or changing the location of the ground rod. It is often the case that a ground rod is driven in close to the building where the filling around the foundation is composed of building material and loose earth. While a rod drives very easy in such a location, the result is disastrous at times.

To read the value of the ground at a substation, we use a voltmeter with a shunt. The value of a 1100-ohm series circuit is marked on the voltmeter as well as the 7000-ohm leakage reading. In reading the ground resistance it is necessary to place a short circuit on the ground at the exchange end so that the reading will be through the joint circuit of the line wires to get the actual operating ground value. This is shown in sketch No. 3.

To cut down the line leakage, trees were trimmed, drop wires replaced on knobs, with brackets for serving off, all inside wiring that might cause trouble was changed to a different location. All drop wire and jumper connections on the iron wire were soldered or equipped with approved test connectors, lightning arresters were installed

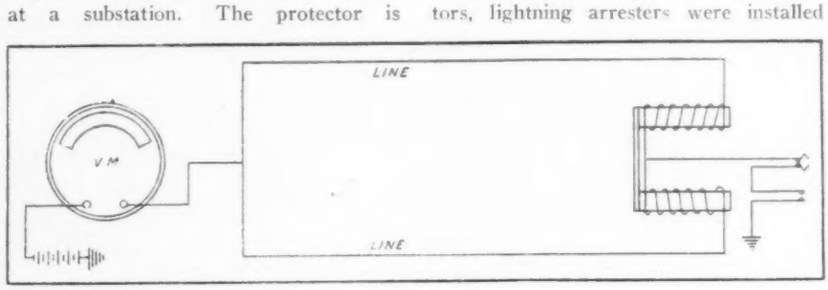


Fig. 3.

on all lines leading to the cable plant, and also at the outer end of the line among the subscribers. These arresters are a valuable aid to the other protectors used in draining dangerous electrical surges off the line. And this type of line arrester will very seldom cause a permanent ground. When such does occur it will be found that the electrodes have been broken off. The cable protection consists of an approved fuse and an air gap sawtooth discharge block as shown in sketch No. 4.

What the Trouble Records Show

The following summary of trouble will show how the system has worked out during a period of 32 months. The data we have compiled covers all troubles which have occurred on the rural system, with the exception of routine work required on the switching apparatus.

Miles of metallic circuit exclusive of cable	1220
Number of metallic rural circuits	65
Average number of telephones	600
Total reported troubles	697
Line Troubles—	
Caused by gang	2
Broken line wires due to frost	58
Short line or drop due to defects	72
Grounded on trees or guys	88
Crossed lines due to defects	64
Miscellaneous line trouble	10
Aerial Cable—	
Open or ground	61
Cable box fuses	23
Rack Troubles—	
Grounded carbons	3
Heat coils blown	5
Total line troubles	378
Substation Troubles—	
Interior wiring	13
Station ground connections (high resistance)	34
House protector carbons	1
Finger stop on dial	4
Calling device (dial) changed	57
Calling device (dial) adjustments	43
Ringer adjustments	73
Receiver cords	23
Transmitter troubles, including cords	9
Mouth pieces changed	2
Receiver caps broken	1
Induction coils changed	2
Receiver hook switch	11
Generator shunts	3
Miscellaneous set troubles	35
Total substation troubles	319

For the period of 32 months these troubles work out at 21 troubles of all kinds per month. There were 114 cases of dial trouble, or 19 dials out of every 100 caused trouble over a period of 32 months, or 7 troubles per hundred per year. A large percentage of these troubles occurred in the first year and were partly due to inexperience on the part of our men in making dial adjustments.

There are 73 cases of ringer trouble. A peculiar feature of the simplex operation of these sets is that if the permanent magnet is polarized in the wrong direction the flow of current through the ringer coils during the progress of a conversation has a tendency to weaken the magnets. We found quite a number

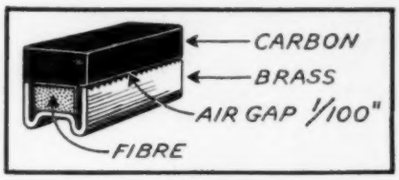


Fig. 4.

of such magnets which caused weak ringer operation. It is also noticeable that a heavy lightning discharge will cause the ringer magnet to lose all its magnetism.

The number of instrument troubles is comparatively small and we wish to point out that there were no instrument troubles due to electrical discharge, which is proof that the protectors were doing their work. There was only one case of grounded carbons that that protector was all blown to atoms.

The number of cable troubles due to lightning is very small. There were 61 cases of cable trouble and among the causes were: A house burned destroying the cable sheath, a bullet hole—a cracked cable sheath causing dampness. And since the rural lines radiate through four different cables the amount of such trouble is reasonably small.

There are some facts we have learned from studying the records of the operation of this system:

1. That automatic operation of rural lines is possible and at a decrease in cost of maintenance.

2. That the service rendered is reliable and well pleasing to the subscriber.

3. That operators are not needed for this class of service.

4. That protection of a rural system can be had without unreasonable cost or interruption to the service.

5. That the troubleman is free in the best working season to make necessary overhaul of the system.

6. Keeping the rural plant in good condition gives better service and in the end reduces cost of making emergency repairs in dirty weather.

Trouble records well kept will furnish valuable data on which to base future plant changes. A study of your protector operation might be worth while. And a change to a better type will more than pay for itself. A protector with a poor ground is a menace while a protector properly installed with a good ground is a safeguard.

Here's How "Hube" Sent Holiday Greetings

Hubenthal, Oklahoma telephone engineer, sent out this unique holiday greeting card. It's "our hero" perched on the pole.

W. B. Scruggs, Harrisonville (Mo.) President, Dies

Harrisonville, Mo.—W. B. ("Ben") Scruggs, president and general manager of the Cass County Telephone Co. died here December 23. For two years Mr. Scruggs had been in poor health. He was prominently identified with local commercial and social activities.

Tri-State Installs 100,000th Telephone in December

St. Paul, Minn.—Tri-State T. and T. Co. formally celebrated the installation of its 100,000th telephone in December. The installation was made in the office of Governor Christianson of Minnesota. President George W. Robinson, George K. Gann, general supt.; R. F. Wilder, commercial supt.; O. A. Knell, plant supt., and other company and state officials took part in the ceremony.

R. A. Gantt Put in Charge of Pacific Division

San Francisco.—R. A. Gantt, formerly chief engineer of the Southern California Telephone Co. has been made general manager of northern California and Nevada section of the Pacific T. and T. Co.

Oklahoma Utilities to Hold Meeting at Tulsa March 9-11

Tulsa, Okla.—Eighth annual convention of the Oklahoma Utilities association is to be held in Tulsa, March 9-11. This is one of the biggest state utilities meetings held, the registration at the last meeting, that at Oklahoma City, being 700.

Simplified Switchboard Maintenance

By JOHN M. WALSHE
(*Assoc. A. I. E. E.*)

In maintaining a switchboard in condition to render its best service, a knowledge of its circuits and their use is necessary.

The present article has for its purpose to show the way to make use of knowledge of magneto switchboard circuits in maintaining the switchboard.

A Simple Testing Circuit

Consulting Figure 4 in the center will be seen five jacks numbered, 1, 2, 3, 4, 5. These are to be used in testing for trouble and clearing it if found.

The ideal to be aimed at is to find troubles and clear them before they are detected by the operator or subscribers. To do this it is necessary to test the cord circuits regularly. How often this may be necessary will depend on the amount of use the switchboard gets and its age.

The five jacks can be wired as shown. No. 1 is a battery jack connected to a single dry cell. No. 2 is bridged to No. 3. No. 4 is connected to a bell through two spare bell coils. No. 4 is connected to the ringing generator.

Routine for Testing Cord Circuits

Each cord circuit should be tested as follows: A head receiver connected to a plug is required. It should be tested first.

1. Insert telephone plug in jack 1.
2. Note click showing circuit is complete.
3. Shake telephone cord; listen for noise.
4. Remove telephone plug from jack 1.
5. Insert telephone plug in jack 3.
6. Insert calling plug of first pair in jack 1.
7. Insert answering plug of first pair in jack 2.
8. Notice battery click showing circuit is not open or short.
9. Shake calling cord listening for noise.
10. Shake answering cord listening for noise.
11. Rock ringing key of calling cord listening for noise.
12. Rock ringing key of answering cord listening for noise.
13. Throw listening key when operator will be heard. Rock this key and listen for noise.
14. Remove plugs from jacks 1 and 2.
15. Insert calling plug in jack 4.
16. Throw ringing key and hear bell ring.
17. Rock this key while thrown and notice that ringing is continuous.
18. Remove calling plug from jack 4.
19. Insert answering plug in jack 4.
20. Throw ringing key and hear bell ring.
21. Rock this key while thrown and notice that ringing is continuous.
22. Insert calling plug in jack 5, clearing signal drops.
23. Remove both plugs.

This routine test informs us if trouble is present, it will not inform us where the trouble is in every case. A noisy cord is, of course, noisy at the place where it is bent to produce such noise.

Four Types of Trouble

There are four troubles which each circuit may have. These are: An open circuit, a short circuit, a cross, and a ground. An open is located by connecting on a battery and following the circuit from point to point with a receiver until the battery is no longer heard. The trouble will be between the last point where the click is heard and the point where it is no longer heard. A short circuit is not so easy. Referring to Figure 4 (as before referred to), at the right will be seen two rows of black squares; these represent places on a circuit at which connections can be made. At other places the wire is covered and not likely to be in trouble. If a short circuit has appeared at X, how are we to find it? Put a battery on the end of the circuit as shown at B. Then current will flow through the trouble. Take a receiver and put it across the first two contacts on one side of the battery; a click will be heard; then move the receiver to the second and third contacts and so on. In the figure six receivers are shown but only one is used in practice. A click will be heard in the first four and the trouble will be at the last point where the click was heard. This will be easily understood by those who remember that the voltage of the battery is all expended in the circuit. The potential falls evenly all along the circuit and in this case the voltage between each connecting block will be about one-eleventh of that of the battery. It is evident that there will not be any difference of potential at the terminals of the last two receivers on the right.

This is one of the most useful methods of locating trouble and is used for crosses and grounds as well as shorts. At the bottom of Figure 1, the method above is applied to the location of a ground. A, B, C, D, E are five pairs

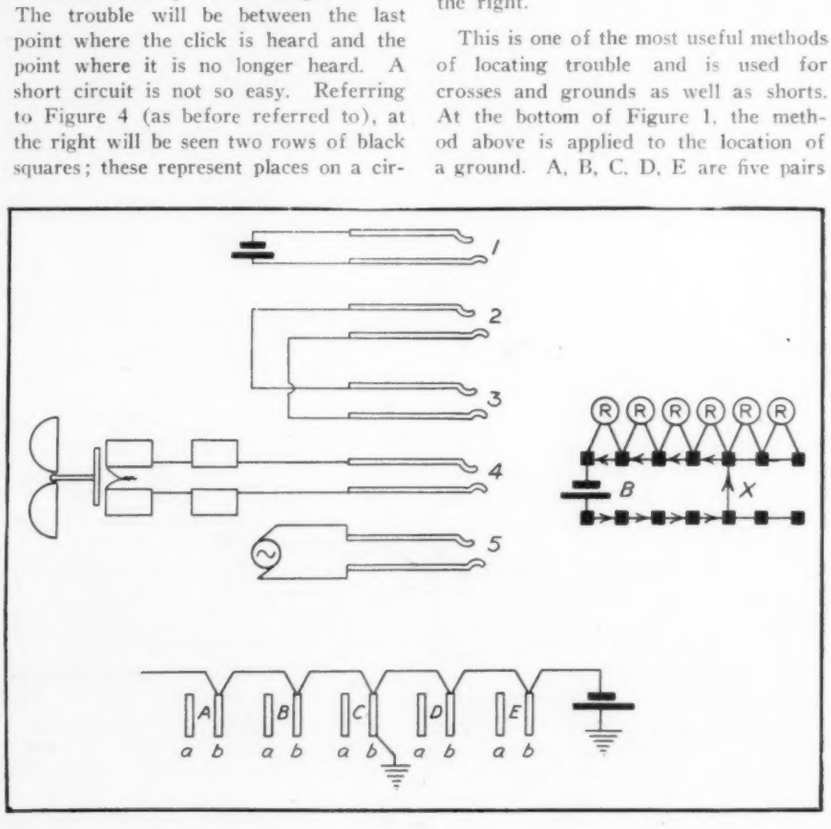


Fig. 1.

of springs and the spring B of the pair C has developed a ground. Now all the "B" springs are bridged if it is a ringing or speaking circuit, so a grounded battery is connected onto one end, a receiver is then taken and starting at the battery end it is connected from spring b of key E to spring b of key D when a click will be heard; a click will also be heard when the receiver is placed from b of key D to b of key C but this is the last place where a click will be heard and the trouble will always be found correctely located.

There is one precaution which must be taken to locate trouble in this way. There must not be any connections to other apparatus; the ends of the circuit in trouble must be left open. If more than one trouble exists it will locate the most distant; when that is cleared it will locate the next, and so on.

It should be noticed that the receivers are put on one side of a circuit only; not across from the line to the return.

Veterans Form a New Manufacturing Company

The Sands Electric Co., North Chicago, Ill., has been formed for the manufacture and sale of telephone protective apparatus and supplies.

The plant has its own railroad siding, and its nearness to Chicago gives to it the advantage of low transportation costs. Another advantage is the large number of workers in that territory, which tends toward low labor costs. The location also has excellent freight facilities which include three railroads, one boat line and several motor truck lines.

The active men in this new company are men of long experience in the telephone field, and particularly in protective equipment manufacture. R. G. Sands, president, is a graduate of the University of Maine in electrical engineering and was with the Dean Electric Co., of Elyria, Ohio, for nearly ten years. During this period he had valuable experience in manufacturing, installation, development and engineering.

Subsequently he was for nearly ten years factory manager of the Frank B. Cook Co. and the Cook Electric Co., where he had full charge of manufacturing. During this period he made many improvements and new designs for telephone protective apparatus and equipment.

For some time past, Mr. Sands has devoted his time to the designing and development of the protective apparatus now being manufactured and marketed by the Sands Electric Co.

R. G. Sands, President Sands Electric Company.

J. C. Ballentine, secretary and treasurer of the company, is a Nebraskan but received his early education in Galesburg, Ill. Graduating from the high school there, he took a preparatory course in Lombard University before engaging in engineering work. He has had over twenty years' experience in the operation of machines, and in the management of factories, producing small mechanical and electrical devices. For the past nine years he has been assistant factory manager of the Cook Electric Co. and its predecessor.

J. C. Ballentine, Secretary and Treasurer Sands Electric Company

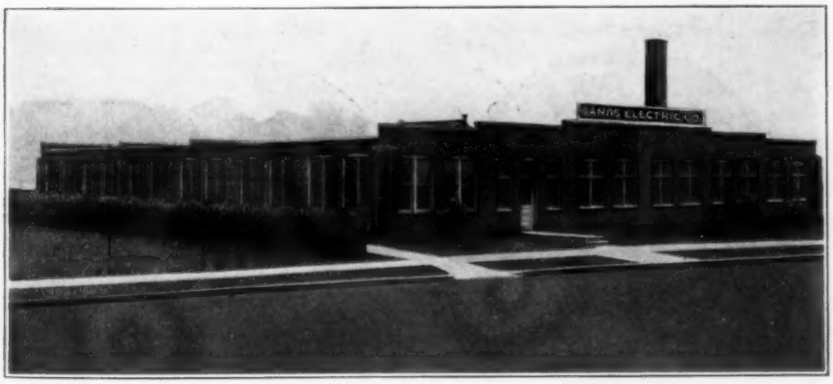
The principal products marketed by the new company are protected and unprotected pole cable terminals, all types of distributing frames and terminal blocks, pole houses, floor and building cabinets, sub-station protectors, lightning arresters, central office protective equipment, supplies and radio parts.

Many years of experience in telephone protection have taught the men of the Sands Electric Co. the difficulties experienced with protective equipment, and the company's new products all are designed with the thought in mind of overcoming every defect and meeting the full demands and needs of the field.

The Sands line of equipment includes:

A new means of making wire connections; "sure contact" self-locking fuse clips which do away with the necessity of a periodical inspection for loose fuses; substation and lightning protectors containing novel and advantageous features; improved designs in pole cable terminal hoods which have no sharp corners to rust and break.

The company's catalog also shows new and improved designs in central office, line and subscribers telephone protective apparatus. Copies of this catalog may be had on request to the Sands Electric Co., 1920 Marquette avenue, North Chicago, Ill.



View of Plant of Sands Electric Co., Located at North Chicago, Ill., with Excellent Shipping and Manufacturing Facilities

How Dial Impulse Directs Automatic Switching

By F. J. DOMMERQUE
(*Fellow A. I. E. E.*)

For the operation of modern automatic systems, even for small ones, a storage battery is an essential requirement. This storage battery and with it the subscriber's station is an inheritance from the manual system, which station has not experienced any change as far as talking and signaling is concerned except that a device has been added for closing and opening the cir-

Fig. 1.

cuits which control the movement of the switches. It is, of course, of importance that such an opening and closing proceeds uniformly to effect an absolutely reliable motion of the switches. This uniform opening and closing of circuits is called "Impulse Sending." Many forms of impulse senders have been constructed but it seems that the so-called "Dial Sender" has obtained a stronghold on account of its simplicity, cheapness and accuracy.

The elements necessary to render an impulse sending device effective are: 1, the operation must be easy; 2, the operation must be accurate, that is, each impulse must be clean cut and complete; 3, it must be reliable; the impulse ratio (the ratio of the time the circuit through the magnet is opened to the total period of the impulse) must be chosen, that external influences (line capacity, defective lines, faulty operation of the dials, etc.) will not affect the impulse sending; 4, it must be uniform, that is, the impulse must take the same time for each pulsation.

The dial type of sending device fulfills all these requirements in a remarkable manner. The following outline is intended to explain the principle underlying impulse sending by the aid of the dialtype for the step by step system represented by the Strowger type of switching and for the powerdrive system represented by the paneltype machine switching system of the Western Electric Company.

Some Typical Dial Fronts

In Figures 1, 2 and 3 the dialfront is shown for three dials; all three have ten fingerholes corresponding with the digits from 1 to 10 (0 designating 10 on the dial). A small telephone exchange containing not more than 10,000 subscribers, that is, not more than four figures in the called-for number, will require first and second selectors or group switches and connector switches, which require a dial with a front as shown in Figure 1 without the addition of any letters. It has been found that using subscriber's numbers with more than four digits is liable to cause confusion, as it is hard to remember more than four digits for a short time; it is much easier to remember a letter and four digits as it would be necessary in a system with 100,000 subscribers. Therefore, for an exchange not exceeding 100,000 subscribers or rather 100,000 lines, a dial of the type shown in Figure 2 is used. The particular design shown in Figure 2 is a European model. The American dial, as a rule, has the letters set in the same space with the digits as shown for the dial Figure 3 designated for a very large exchange requiring three letters and four digits in its numbers.

The letters and digits are not on the front plate but on another plate called the numberplate. The white circles appearing in the illustrations are on this number plate, and are visible through holes, called the finger holes, cut in the front plate. The number plate is fixed, while the front plate can be moved about a central pivot by placing the finger in the hole indicated by the digit in the desired number and drawing the dial in a clockwise direction until the finger strikes the fixed stop (shown to the right of 0 in the three figures),

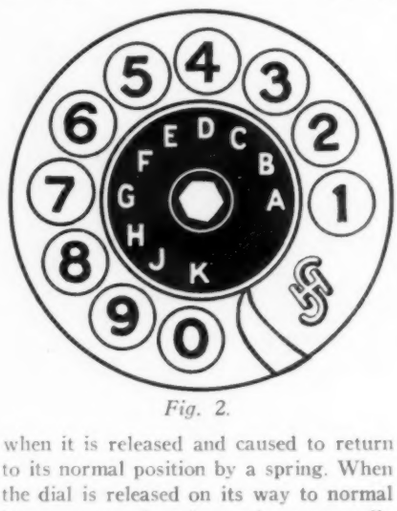


Fig. 2.

when it is released and caused to return to its normal position by a spring. When the dial is released on its way to normal it causes two impulse springs, normally closed, to open a number of times corresponding to the digit set, the opening and closing of the springs being periodic and governed by some mechanical means attached to the shaft of the dial or controlled by its rotation. To prevent clicks in the receiver a pair of shunt springs, indicated in the dial circuit diagram Figure 4, is provided which is

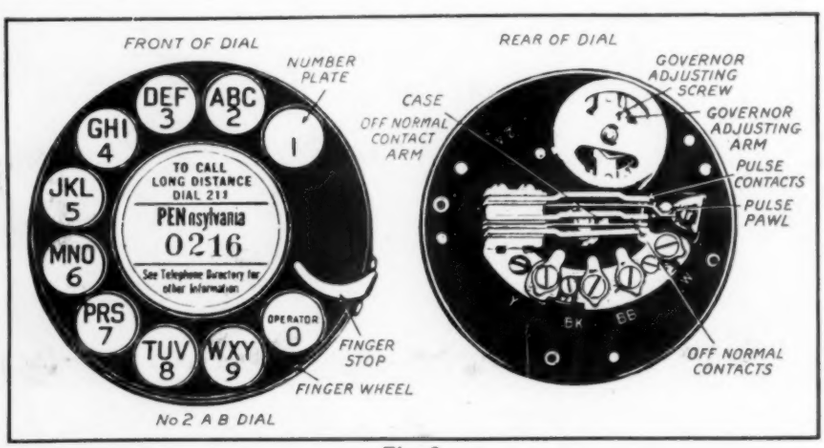


Fig. 3.

closed as soon as the calling subscriber rotates the fingerplate. The shunt around the transmitter and receiver is maintained until the plate returns to normal. The transmitter resistance is an uncertain quantity and it is of importance that unnecessary resistances are excluded from the path of the impulses. The makes and breaks in circuit Figure 4 (Automatic Electric Company's dial circuit) are effected by a revolving cam having the shape of a butterfly; its wings slide in and out between two fixed impulse springs; the cam is geared to

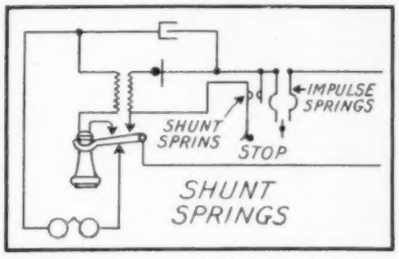


Fig. 4.—Dial circuit (Automatic Electric, Inc.)

the shaft so that one make and one break is made for every half revolution. The spread at which the cam revolves is controlled by an escapement geared to a small contrifugal governor, whereby a uniform movement is obtained.

How Impulses Control the Switches

For a further understanding of the process of impulse sending and the action of apparatus involved therein it will be necessary to give some idea of the controlling circuit. Mr. A. B. Smith gave a skeleton diagram of this circuit in the Transactions A. I. E. E., December, 1919, which is reproduced in Figure 5. The circuit contains the most necessary apparatus for the control of a connector switch of the Strowger type. The line switch is not made part of this circuit as it does not contribute to the impulse sending.

At the left side of the figure the impulse springs C D are shown, which are opened and closed as many times as there are units in the digit of the number the subscriber dials. Associated with the switch to be operated from the dial is a line relay L R, which is actuated in unison with the impulse springs. Each release of the line relay causes the vertical magnet V M to take a step. The first operation of the line relay closes the circuit through the release relay (Rel. Ry.). This relay is of the slow releasing type, which means that its armature is prevented from falling off immediately after cessation of current flow on account of a counteraction against the change in the magnetic field caused by a copper collar or shell put around part of the core of the relay for about one-third of the winding space, this collar acting substantially as a short circuit; consequently the release relay will retain its armature closed during impulse sending.

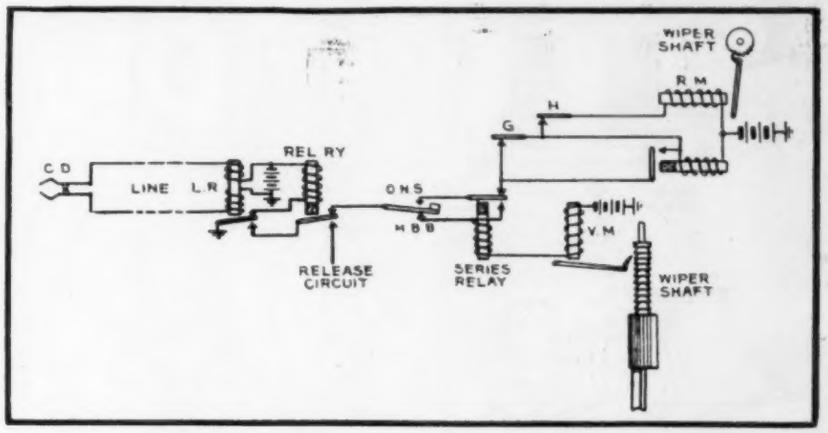


Fig. 5.—Controlling circuit for automatic switchboard.

The first time the line relay is deenergized the series relay, also a slow-release relay, is actuated and remains actuated during the series of pulsations to which the vertical magnet V M responds by lifting the switch shaft the required number of steps. At the termination of the impulse sending the line relay remains energized, the series relay releases its armature which changes the local circuit so that the impulse sending can take place through the rotary magnet R M.

In a step-by-step motion system, of which the Strowger type is the best known representative, the switches (selectors and connectors) are 100-line switches. The numbering of these 100 lines or rather the principle of numbering of a connector switch is shown diagramatically in Figure 6. As the "0" on the dial means "10," the sequence of the numbers in the connector bank must be arranged correspondingly as will be seen from the figure. The number 10 for instance calls for one vertical and ten rotary steps. As, therefore, the switch bank is arranged on the decimal basis, the impulses from the dial can be used for the control of the stepping of the switches without changing their sequence. With other words, the step-by-step system operates with a "direct impulse control."

Power Driven Switches Are Not Directly Controlled

In the powerdrive system used by the Bell companies and also in Europe in such exchanges where the Western Electric rotary machine switching is employed, the switches are differently arranged as far as their numbering is concerned and do not permit of a direct control by the impulses originated by the subscriber on a decimal basis. Instead, these impulses are registered by a register and the motion of the switches is effected or controlled by impulses sent out from the switches through the registers, these impulses do not need to be, and in the panel type switching system are not, on the decimal basis.

In Figure 7 is shown the route of a connection from a full machine switching or mechanical station to another full mechanical station or to a manual station. The connectors or the "Final Frames," as they are called in the

01	02	03	04	05	06	07	08	09	00
91	92	93	94	95	96	97	98	99	90
81	82	83	84	85	86	87	88	89	80
71	72	73	74	75	76	77	78	79	70
61	62	63	64	65	66	67	68	69	60
51	52	53	54	55	56	57	58	59	50
41	42	43	44	45	46	47	48	49	40
31	32	33	34	35	36	37	38	39	30
21	22	23	24	25	26	27	28	29	20
11	12	13	14	15	16	17	18	19	10

Fig. 6.—Numbering of Connector Line Bank.

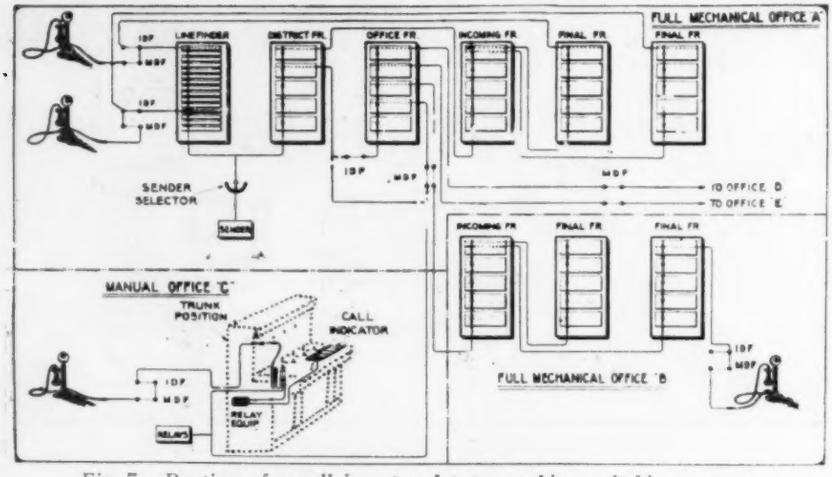


Fig. 7.—Routing of a call in a panel type machine switching system.

paneltype system, are divided into five banks of 100 lines each, each bank consisting of 10 groups of 10 lines each. The numbering in the lowest bank is 0 to 99 or 500 to 599 or 1000 to 1099, and so on; the numbering in the second bank is 100 to 199 or 600 to 699 or 1100 to 1199 and so on; in the third bank 200 to 299 or 700 to 799 or 1200 to 1299 and so on.

The "Incoming Frames" in Figure 7, which are comparable to selectors or group switches in the step-by-step motion system, are divided into five banks of four groups or 25 trunks each; the lowest bank contains the trunks to subscribers 0 to 1999 (in a 10,000 line exchange) divided into the four groups: 0 to 499, 500 to 999, 1000 to 1499 and 1500 to 1999. The second bank contains the trunks to the subscribers 2000 to 3999; the third bank the trunks to the subscribers 4000 to 5999; the fourth bank the trunks to the subscribers 6000 to 7999 and the fifth bank the trunks to the subscribers 8000 to 9999. As will be seen, this division deviates from the division on a decimal basis as cited in the usual step-by-step motion switches and, therefore, some means must be devised to transform or "translate" as it is termed in powerdrive switching parlance, the impulses sent out by the dial on a decimal basis into the non-decimal basis of the arrangement of the 500-line switches. The method of impulse sending in this case is termed the "Reverse Impulse Control."

A new piece of apparatus, or rather a new combination of apparatus, is introduced between the linefinder frame, on which the subscriber's lines terminate, and the incoming trunk frame (or in case of a very large exchange which requires division into districts as illustrated in Figure 7 between linefinder and district frame) called the "Sender." In the sender the impulses from the dial are received on the decimal basis and are translated into impulses on the non-decimal basis for connection. An idle sender is selected by the subscriber when making the call. The impulses from the subscriber's dial are received and registered by the so-called "Registers" as stated before. There is one register for every letter, if such are used for district and office selection, one for the thousands, one for the hundreds, one for the tens and one for the units selection.

The sender is the heart of the powerdrive machine switching system and as such deserves a discussion by itself, which will be given at some future occasion, but here a short account will be presented of the dial and its circuit as used in the paneltype system, although there is no material difference between the dial already described and the one to be described presently.

In reference to Figure 7 it may be said that in very large offices a district frame permanently associated with a linefinder, selects a trunk to the desired office either directly or through an office frame in case the number of trunk groups is too large to be placed on the district frame. Assuming that the desired office is a full mechanical office, the trunk chosen will terminate at an incoming frame and thence the call will proceed to a final frame to which the called-for party is connected.

If the call had been for a subscriber in the originating office it would have been routed from the district frame to an incoming frame in the same office and thence to the final frame in which the called-for subscriber's line is located.

The dial illustrated in Figure 3 gives the front and rear view of a Western Electric dial as used for paneltype machine switching stations for very large exchanges, in this particular instance for the Pennsylvania office of the New York Telephone Co. It will be noticed that to the numerals 2 to 9 the letters of the alphabet are added, three letters to each numeral. The letters serve for connection to the office wanted and the numerals for connection to the subscriber in the office. For each office the subscribers are listed in the directory by the office name and a number, but the three first letters of the office name are printed in capitals; the subscriber first dials the three capital letters and then the number, which in New York consists of four digits. The dial circuit is shown diagrammatically in Figure 8, wherein the finger plate is indicated by dotted lines. The drawing illustrates the usual common battery subscriber's station circuit with the addition of the essential elements of the dial. The transmitter cut-out key 9 is not essential and may be omitted. The plate 11 is mounted upon an axis 12 which also carries the impulse wheel 13 and the arm 14, the latter engaging a contact spring 15 when the finger plate is in its normal position, whereby the contact spring will be engaged with contact 16 to close the subscriber's station circuit at this point. The dial sender further includes a small bell crank lever

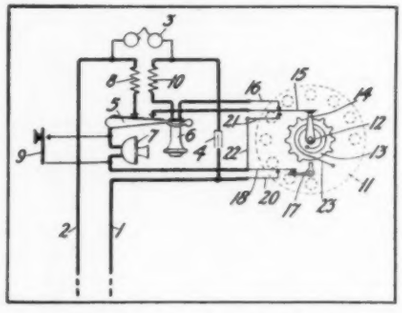


Fig. 8.—Western Electric dial circuit.

17 adapted to be engaged by the teeth of the impulse wheel 13 on the return movement of the finger wheel to normal position, to vibrate the contact spring 18 for impulse sending. Upon the initial rotation of the finger plate 11 arm 14 will cause springs 15 and 21 to close and shunt the transmitter 7.

Telephone Pioneers of America to Meet at New York in August

New York City—Fifth meeting of the General Assembly and thirteenth meeting of the Telephone Pioneers of America, the Bell veteran society, will be held on Friday and Saturday, August 27 and 28 at New York. Headquarters will be at the Commodore Hotel. H. B. Thayer is president of the society and R. H. Starrett secretary.

Exline (Ia.) Company Plans Busy Year

Exline, Ia.—Caldwell Mutual Telephone Co. at its annual meeting elected G. W. Traxler, president, and Eurus Johnson, secretary-treasurer. The company plans to extend its farm lines during 1926

An Account of Stewardship

FIFTY years ago Dr. Alexander Graham Bell was busy upon a new invention—the telephone. The first sentence had not been heard; the patent had not been filed; the demonstration of the telephone at the Centennial Exposition had not been made. All these noteworthy events were to occur later in the year 1876. But already, at the beginning of the year, the basic principle of the new art had been discovered and Bell's experiments were approaching a successful issue.

The inventor of the telephone lived to see the telephone in daily use by millions all over the world and to see thousands of inventions and developments from his original discovery.

If he had lived to this semi-centennial year, he would have seen over 16,000,000 telephones linked by 40,000,000 miles of wire spanning the American continent and bringing the whole nation within intimate talking distance. He would have seen in the Bell System, which bears his name, perhaps the largest industrial organization in the world with nearly $3,000,000,000 worth of public-serving property, owned chiefly by an army of customers and employees.

He would have seen developed from the product of his brain a new art, binding together the thoughts and actions of a nation for the welfare of all the people.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

Accuracy and Simplicity Are Testing Keynotes

By P. KERR HIGGINS

Testing Methods in Telephony

A correspondent asks for information regarding the Sage ohmmeter, so a brief description of it is given herewith. The principle of this instrument is practically the same as other ohmmeters which

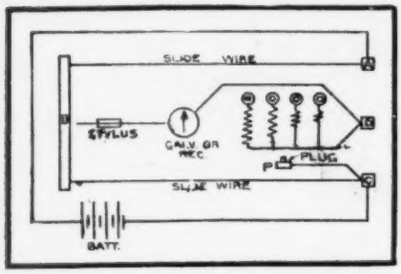


Fig. 1.

have been described in preceding article. The circuit arrangement for ordinary measurements is shown in Fig. 1. In Fig. 2 the arrangement is shown for locating a ground. It is to be noted that this instrument is only available for the Murray loop test. The detector may be either a galvanometer or a telephone receiver as indicated in other bridge tests and a switch is usually provided for changing from one to the other. It is also possible to use either direct current from dry cells or an alternating current as desired. To measure ordinary resistances, the resistance to be measured is connected to the two posts marked +. The plug P is then inserted in one of the four sockets shown and the point of balance (or silence) is found by passing the stylus along the slide wires. The desired resistance is thus indicated opposite the stylus on the scale corresponding in color to that of the socket in which the plug is placed.

In making the Murray loop test, the grounded conductor is connected to the binding post A and the good wire to the binding post C. The binding post D is also connected to ground. The loop is short circuited at the distant end and the plug is then taken out of the socket and allowed to hang free. The percentage strips which are furnished with the apparatus should now be laid over the scales of the instrument, with the 0% or zero end next to the binding post A and the 100% end next to the binding post C. The stylus is then passed over the slide wires until a balance is obtained. The distance to the trouble from the instrument is then equal to the percentage reading obtained multiplied by twice the length of the loop, provided both sides of the loop are of equal gauge and length. If of unequal size or length, then the rules given in the November issue of TELEPHONE ENGINEER should be used.

Where the length of the loop is not known, it can be measured approximately by using the following constants. Measure the loop resistance of a pair of wires and multiply this result by 31 for No. 22 B. & S. gauge wire and by 61 for No. 19 B. & S. gauge wire, as this is the length in feet of a loop whose resistance is one ohm. Another method is to multiply the percentage reading by the loop resistance which gives resistance in ohms from the instrument to the trouble. Then this result multiplied by 62 for No. 22 B. & S. gauge wire or 122 for No. 19 B. & S. gauge wire gives the distance in feet from the testing point to the trouble.

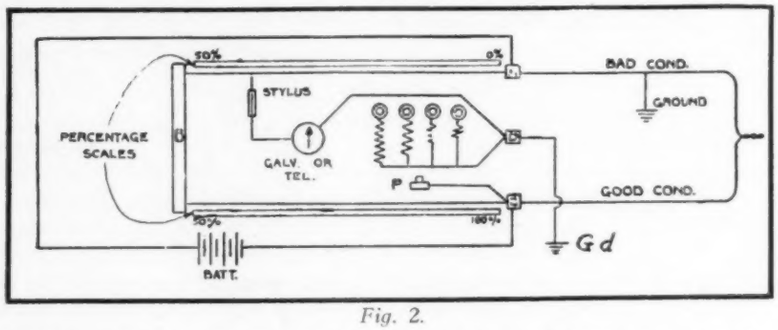


Fig. 2.

In Fig. 3 is shown the arrangement for testing and locating a cross between two wires, which is self-explanatory. As a check on these tests reverse the two wires connected to A and C and if the point of balance gives the same number of scale divisions on the percentage scale as it did in the previous test, it may be assumed that the location is reasonably accurate. In using the percentage reading the figure obtained should be considered in decimal form, that is, 30% should be considered as .30.

Tests for open conductors by means of this instrument are not very accurate. However, the circuit is shown in Fig. 4. In making such a test a good pair should be chosen terminating at the same point as the bad pair and both must be perfectly insulated from the ground and from each other. The plug P is then withdrawn from the socket as before. The battery switch is thrown to A C position and the detector switch to the telephone position. The buzzer is then started and should be heard in the receiver. The point of balance is obtained by a minimum or no tone in the receiver. The equally divided scale should be placed in position as in the previous test and the following formula used:

$$\text{Distance to fault} = \frac{\text{Length of cable multiplied by \% Reading}}{100\% - \%\ \text{Reading}}$$

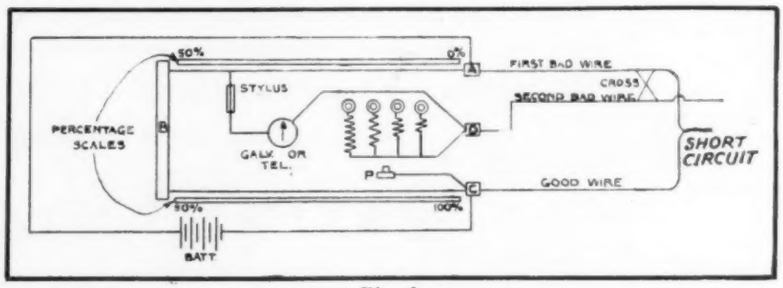


Fig. 3.

Wireless Testing

In addition to the portable sets dependent upon the Wheatstone bridge principle, there are many so-called "wireless test sets" operating on the induction principle (TELEPHONE ENGINEER, December, 1925, page 38). The principles of these are practically the same except that a few refinements have been introduced

GraybaR

QUALITY

A new name that's fifty-six years old

GraybaR

Western
SUPPLY

Changes name—

Effective January 1st, that part of the Western Electric Company known as the Supply Department takes Graybar Electric Company as its name. This involves no change whatever in the existing distributing organization. Nor does it affect the facilities offered to buyers of electrical supplies all over the country. The significance of the change is found rather in the source of the new name, 56 years earlier in the history of the company.

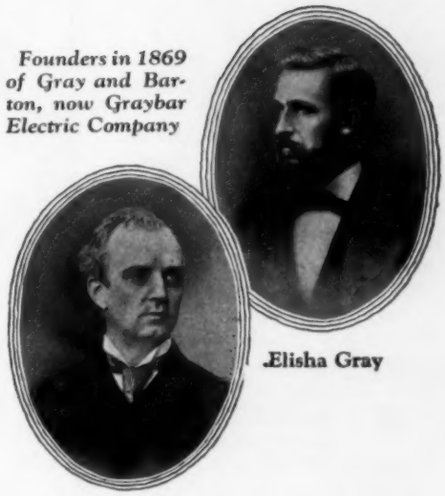
In 1869 Gray and Barton began the making of electrical supplies. In the early seventies Western Electric was adopted as the company name. After Bell invented the telephone in 1876, telephones were added

Electric
DEPARTMENT

to the line, and in 1882 the company became the manufacturing department of the Bell Telephone System.

During all these years the company has carried on at the same time a merchandising business under the title of the Supply Department, selling to the American public all types of electrical products. The growing complexity of these dual responsibilities—on the one hand, to the Bell Telephone System; on the other, to the general user of electrical supplies—now makes it advisable to separate the two functions. Hence the Supply Department, serving as before in every electrical field, becomes a distinct corporate organization.

It takes the name Graybar, derived from Gray and Barton. A new name; but carrying with it a reputation 56 years old.



Founders in 1869 of Gray and Barton, now Graybar Electric Company

Elisha Gray

Enos M. Barton

GraybaR
ELECTRIC
COMPANY - - - INCORPORATED

SUCCESSOR TO SUPPLY DEPT.
Western Electric

GraybaR

QUALITY

Looking forward to the next fifty-six years of service

GraybaR

ELECTRIC

COMPANY - - - INCORPORATED

SUCCESSOR TO SUPPLY DEPT.

Western Electric

which varies the type and usually results in higher efficiency. Among these may be classed the "Telafault," the "Woodpecker" and the "Stewart." In addition to these there are many others, but these are the ones principally in use and a description of any one of them would give the principles upon which they are designed. If the memory of the writer is correct the Telafault was one of the first, if not the first of this type of instruments, and it is his recollection that this instrument was developed by W. O. Pennell and H. Louis Hoffman, both of whom were and still are connected with the Bell Telephone Co. The writer was shown the first set in Kansas City, Mo. A brief description, therefore, of this type of instrument will probably be interesting to the reader. This instrument in recent years has been somewhat improved and I believe is now known as the Matthews Telafault or Woodpecker.

Briefly the principle is that of sending out over the faulty conductor a pulsating current. An exploring coil is wired to the terminals of the head receiver, which is worn by the tester. The exploring coil is placed against the sheath of the cable and noise due to the induction from the interrupted current is heard. The coil is then moved along the cable until the trouble has been reached, when the noise will cease. The exploring coil and set furnished is so designed that by proper adjustment, all return currents in the sheath of the cable tending to affect the positive location of the trouble are neutralized. The special coil provided with the instrument should be used rather than an ordinary receiver, as otherwise the return current in the sheath develops inductive noise which results in a false location or no location at all. Having established a

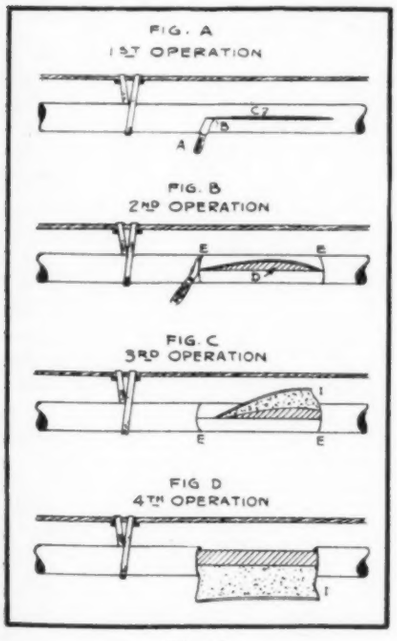


Fig. 6.

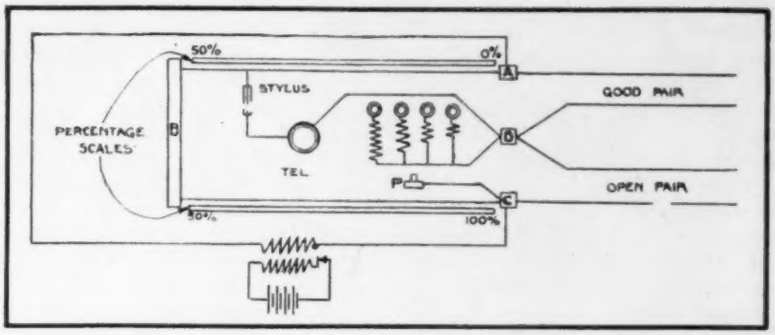


Fig. 4.

closed circuit through the conductors in trouble and a source of energy, it is apparent that current sent out over one side of the line will return via the others with more or less loss largely governed by the electrical efficiency of the circuit. It might therefore be said that beyond the point constituting the end of this closed

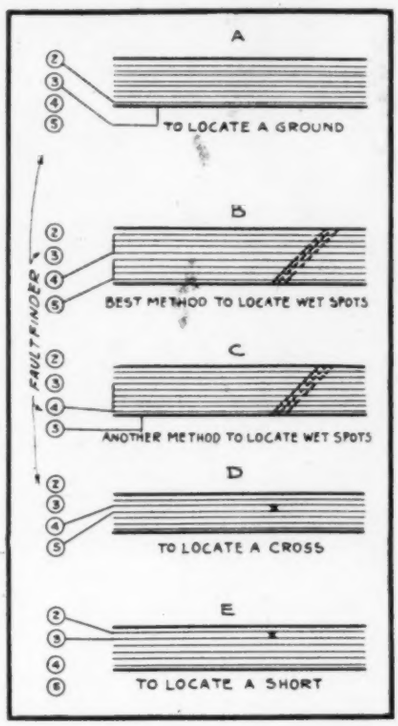


Fig. 5.

circuit, no current will be detected. For this reason and others the writer has found it best wherever possible and practical to use the conductors of the cable in trouble as a return circuit rather than use the sheath for this purpose. In other words where a cable has a wet spot or a burn causing a more or less short circuit, the conductors are made up into two groups and bunched together with their distant ends open and clear of all electrical connection. One group is used for the outgoing and the other for the return circuit.

The chief cause for failure in location is usually found to be the interference set up by stray currents which exist in every cable system due to other sources. Hence, a detector to be of maximum value must be so designed that it will register only the induction produced by the known source of energy used in charging the closed circuit.

In using the Telafault, the operating switch is closed and vibrator permitted to operate freely. It should be so adjusted as to operate at from one half to two-thirds the frequency of the regular ringing current, or from six hundred to eight hundred vibrations per minute. The frequency is determined by the sound produced in the receiver when the exploring coil is held over the magnets of the interrupter. The correct adjustment is to have the arm of the armature adjusted to clear the heads of the magnets about one-sixty-fourth of an inch. Before proceeding with the test, it is well to short circuit the line post A and B and observe the spark at the carbon block when the armature strikes it. If a spark is noted, thus indicating a flow of current, the set is ready for use. The method of using the exploring coil has already been explained. However, great care must be taken in its use to follow the pairs around the cable; that is to pass or hold the exploring coil along all sides of the cable for a distance of not less than one foot. In order to have a minimum of resistance between the battery and the fault, the interrupter should, if possible, be attached directly to the wires in trouble and as close to the trouble as practical. The number of cells used may vary from two to seven according to the judgment of the tester and the nature of the trouble to be located. This may be increased if test is made at office.

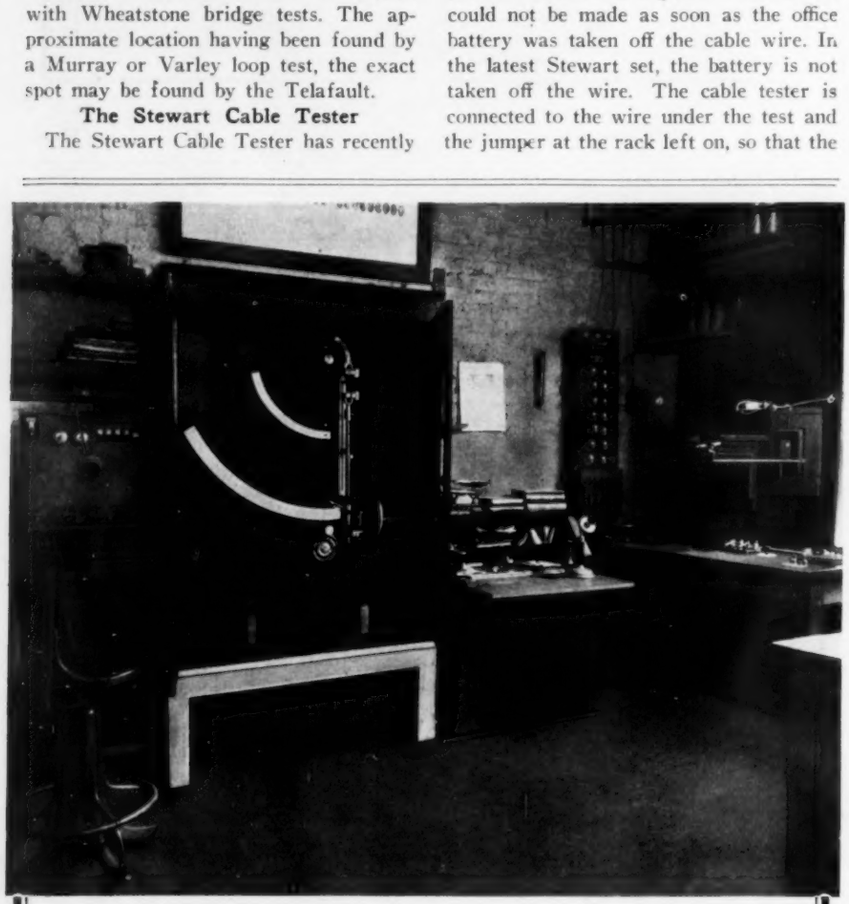
The magnitude of the induction depends, of course, upon the strength of the field produced by the interrupted current around the conductor in trouble; and, also, upon the distance between the conductors in trouble and the sheath. With a high resistance ground, as for example in a cable which is only slightly wet, it may be difficult to get enough current through the fault to be heard in the coil. This can usually be overcome by increasing the voltage of the battery.

In locating short circuits, the induction is generally not so loud as in ground or

crossed wire locations, for the reason that the current from the interrupter and the return current tend to neutralize each other due to the twist of the pairs in the cable. By moving the coil around the sheath of the cable one is enabled to catch the pair in trouble where it is closest to the sheath and in this way receive the maximum induction or noise. This instrument is also valuable in connection with Wheatstone bridge tests. The approximate location having been found by a Murray or Varley loop test, the exact spot may be found by the Telafault.

The Stewart Cable Tester

The Stewart Cable Tester has recently become quite popular due to some refinements which have been made in the circuit, for which it is claimed that the possibility of the tone going past the fault is eliminated, or nearly so. One of the reasons for failure in the use of the induction method of testing a wet cable is due to the fact that the resistance of the water between the wire and the lead sheath increases to a point where a test could not be made as soon as the office battery was taken off the cable wire. In the latest Stewart set, the battery is not taken off the wire. The cable tester is connected to the wire under the test and the jumper at the rack left on, so that the current goes out over the wire to the fault and thus keeps the resistance down. The cable tester is so arranged that it will not short circuit the current from the line. In cases where the relay or battery feed does not have enough inpedence to keep the current from the cable tester out of the battery, a repeating coil is used, one side being connected in series with the jumper wire on the battery side of the line. In other cases a battery tap can be connected through the winding of a repeating or other inpedance coil, such as a ringer coil.



On local battery exchanges, fifteen or twenty cells can be connected in series with a 500 ohm drop or ringer coil and this can be used for impedance, the dry cells taking the place of the central office battery. One side of the battery is grounded and the other side is connected through the ringer coil to one side of the cable pair. By connecting the battery on to the bad cable pair and leaving it so connected for some length of time, say over night, the resistance of the fault can be materially reduced. Details of this test can be obtained from the makers of the Stewart Cable Tester.

The writer has found it of great benefit in making any tests not to be satisfied with a test from one end of the circuit in trouble, but to make a verifying test at the distant end and, if the cable is multiplied, at points as close to the actual location as practical. As a general rule diagrams are furnished in the lid of the carrying case of the set and these should be examined carefully and understood thoroughly before any tests are begun. The instructions issued with the set should also be closely followed. The manufacturers are generally glad to hear from users of their instruments and very willing to co-operate with and assist them in solving problems which present themselves during tests.

A few hints in the use of this type of set may not be out of place in addition to the instructions usually given. First, the vibrator should be adjusted to operate at as low a frequency as is consistent with a uniform tone. In the Mathews set, the secondary of the induction coil is provided with two windings, called "high" and "low." Terminals 4 and 5 are connected to the high winding and terminals 2 and 3 connected to the low winding coils. In locating grounds, short circuits, crossed or split pairs, the low windings should be used wherever possible. To determine the proper winding to be used, connect the conductor or conductors in trouble to either the high or low winding and then test for the tone with the exploring coil at some convenient point on the cable and note the volume of tone in the receiver. Then connect the conductor or conductors in trouble to the other winding and compare this tone with the previous one. The winding which

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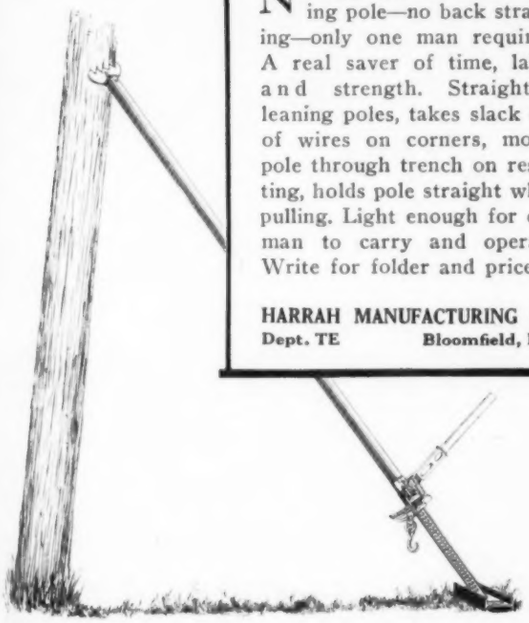

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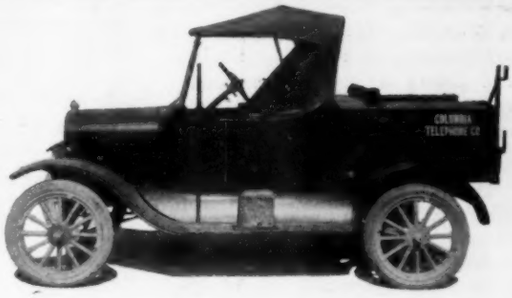

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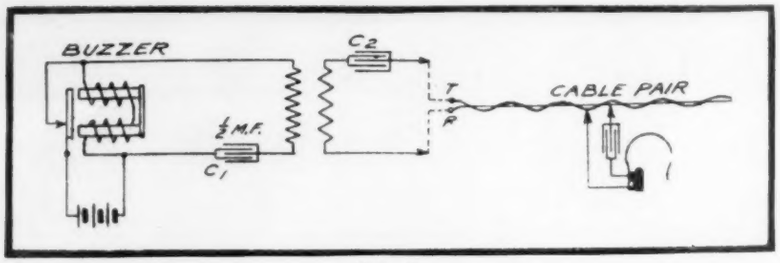

Fig. 7.

gives the greatest amount of tone in the receiver, is the proper one to use. Fig. 5 shows some of the combinations which may be used to good advantage and are self-explanatory.

When locating high resistance grounds, the tone will sometimes be heard beyond the location of the fault. The only way known to the writer to overcome this is to note the point at which a noticeable decrease in the volume of the tone occurs. In such cases it is also well that the fault finder be connected to the defective conductor at the terminal which will leave the shortest possible length of conductor beyond the probable location of the fault. By doing this the capacity effect of the conductors beyond the fault will be reduced to a minimum. Sometimes when the fault has been located there will be no evidence on the sheath of any trouble and even if any evidence of trouble exists great care should be taken in removing the sheath.

As a general rule the trouble is located and temporarily repaired by a trouble man, who does not always know the proper method of removing a sheath. Fig. 6 shows a suggested method of doing this. After the sheath has been removed, the cable should be thoroughly boiled out with paraffine until all moisture has been expelled. The opening is then thoroughly covered with several layers of muslin, in strips two inches wide and again boiled out with hot paraffine. When this has set, if permanent repairs cannot be made at once, the opening should be taped and then be given a thorough coating of "Ever-Protect Compound."

Identifying Cable Pairs

Another phase of telephone testing is the location or identification of the individual pairs in a cable, either for splicing terminals or for locating pairs in trouble. The following is suggested as a simple method for identifying cable pairs, when only one man is available: It is customary to arrange and connect up cable pairs on the line side of distributing frame, being careful to keep the pairs intact, that is, not spliting pairs. Connect the white of one pair to the red of the adjacent pair throughout the entire cable with a temporary connection. Now connect one side of a battery consisting of two or more cells arranged in series to the red wire of pair one and connect the other side of this test circuit to the cable sheath. Now, go to the distant end of the cable and connect one terminal of a receiver of the cable sheath and use the other side of the receiver as a feeler to find the red wire of pair No. 1, which will be indicated by a click in the receiver on touching the correct wire. If the wires are properly paired, you have now found pair one. Twist the ends together and this will bring battery to the red wire of pair No. 2. Repeat this operation until all pairs are identified.

Another method of identifying pairs when two men work together is shown in

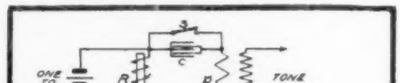

Fig. 8.

Fig. 7, using a buzzer to produce alternating current. To use this test, first apply it to a known line and let the tester accustom himself to the loudness of the tone. It should not be loud enough to make much noise on other pairs. Leave the tone on the line while the trouble man with a head receiver and condenser, as shown in the diagram, goes out to test by getting across pair after pair until the right pair is located. When the trouble man has located the proper pair he may indicate this fact to the tester by short circuiting the condenser. If desired, a relay may be bridged across the pair so the trouble man can get the wire chief direct or the wire chief can wait on the pair with the condenser, in series with his talking circuit.

Tone Test Outfits

The arrangements for producing tones or testing are legion and sometimes it seems as though every cable splicer had a tone circuit of his own design. It would therefore be a difficult matter to attempt to cover this wide range of circuits and we must therefore be satisfied with a few examples upon which all tone circuits are based. In Fig. 8 is shown the principle of the tone test. A relay R of the spring cut off type with a winding of about 30 ohms resistance is wired up like a buzzer. A small spring such as a half length of the kind used on telegraph relays is connected to the armature and pulls in the direction of assistance. The object of this spring is to enable us to make the tone "fine" and uniform. To the contact is attached another spring somewhat stronger than the other and pulling in the same general direction. This spring assists the contact in breaking, and should normally be rather stiff. This spring should first be adjusted to cause the contacts to open with the battery on and the armature spring loose. It should then be released until the tone starts, when the tone may be adjusted by means of the armature spring.

An induction coil is connected across the winding of the relay, using the primary for high and the secondary for low. A condenser C is connected up in series with the relay and coil in order to keep

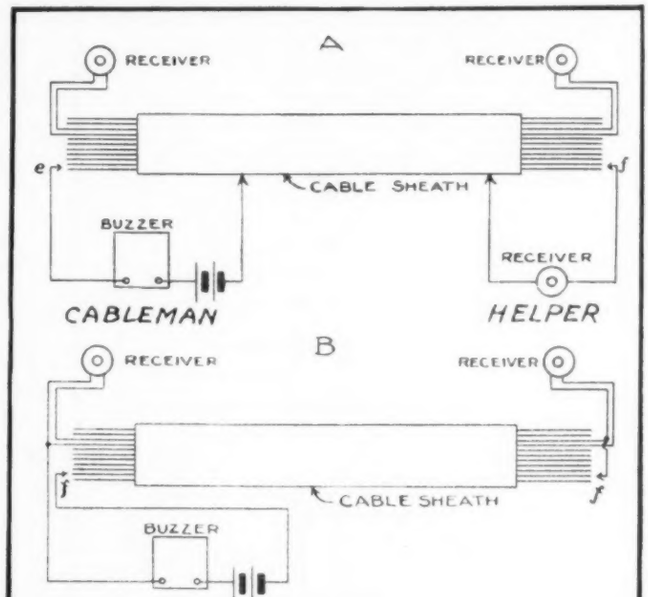

Fig. 9.

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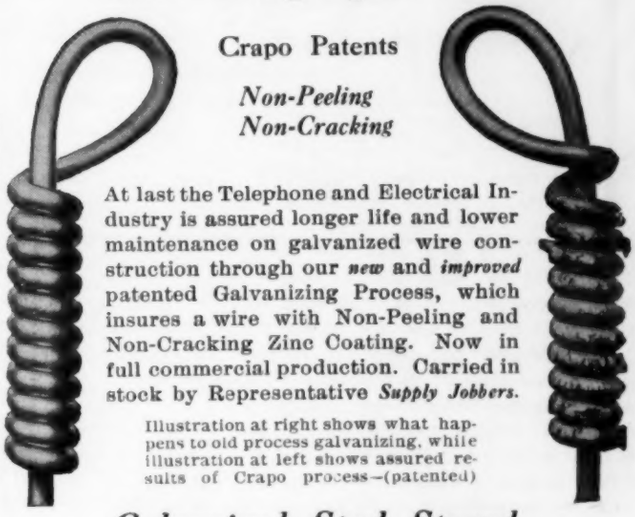

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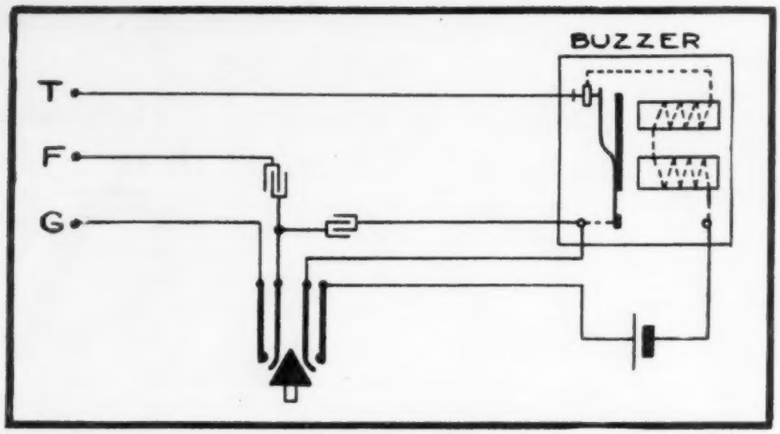

Fig. 10.

the tone low when it is being used for tone purposes and also for saving the battery. In order to increase the strength of the tone a switch S is provided for short circuiting the condenser. The low connection gives a tone of very strong current value and is generally used in locating trouble, provided that the resistance of the circuit across the terminals is less than one hundred ohms. If, however, the circuit has a higher value, then the high connection should be used for this purpose.

In Fig. 9 is shown the use of the tone tests in identifying pairs and using the needle for this purpose. From these diagrams, it is apparent that while the tests employed do not seriously interfere with the service of magneto exchanges they would seriously interfere with the service on common battery exchanges. The requirements of a testing outfit for use on central battery lines are as follows: First, the line signal or lamp at the central office must not be operated; second, noise or induction from the testing set must not be great enough to interfere with conversation over the lines; third, the apparatus must produce a signal, which for the purposes of the cable men, must be as distinct or more so than that produced by the generator or buzzer; fourth, the circuit must be simple and the apparatus easily repaired. Such tone set is shown in Fig. 10. The buzzer should be of low resistance, say from two to three ohms. The condenser may be of any convenient capacity. One or two cells are sufficient for power. The key is inserted for convenience in opening and closing the battery circuit. Some of the methods of using this tone test are shown in Fig. 11. This set makes up a very convenient tone test for cable man and helper in testing out cables.

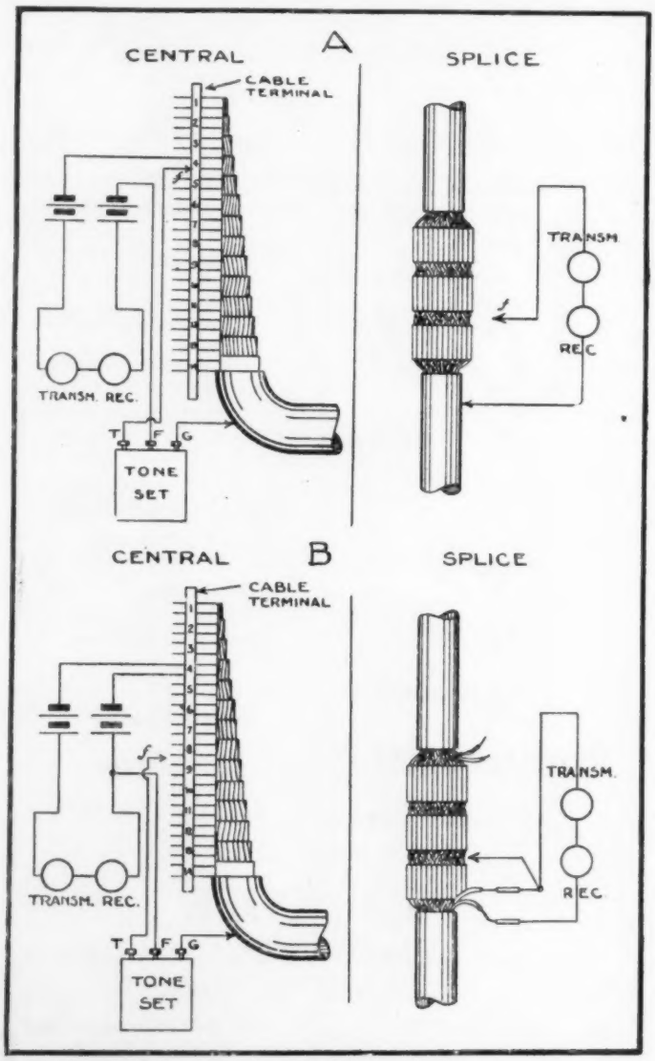

Fig. 11.

Many Call, Few Chosen As England's Operators

London, Eng.—In 1925 only 1,551 girls of the 9,325 applicants for positions as operators in the British government telephone service were able to qualify. Chief causes of failure were said to be defective or slovenly speech, undesirable accent, defective hearing or eyesight, and bad spelling.

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Am. Elec. No. 36 3-bar 1000 or 1600 ohm Bdg. compacts @ $6.50—4-bar @ $7.00—5-bar @	7.75
Kellogg No. 2805, 3-bar, 1000, 1600 or 2500 ohm Bdg. hotel sets @	7.00
Dean or Garford 3-bar, 1000 or 1600 ohm Bdg. desk sets @ $8.75—4-bar @ $9.25—5-bar @	10.25
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LINE AND DESK

ARTICLE IN EVERYDAY ENGLISH

A very interesting letter comes to us from J. P. Whitson of Hope, Ark., in which is expressed a difficulty that arises with many practical men. Mr. Whitson says in part: "Please explain through your columns why all tests and instructions for measurements are always expressed by formulas. Why doesn't some guy have a heart and explain in common English so an ordinary lineman who has never been past common fractions in mathematics can understand? Even the instructions that come with the instruments are the same way. I can use a galvanometer on plain and Varley loop tests but would never have been able to do so unless I had had personal instructions. Even the valuable articles by Mr. Higgins are mostly away above the ordinary lineman's head. Please, oh please, you engineers, give us some plain English articles also —so you will help us everyday linemen."

Before giving some of our own ideas on the subject, we would like to comment on one aspect of Mr. Whitson's case which probably he himself does not recognize. He modestly says that his knowledge of mathematics does not go beyond common fractions and yet he tells us that he can use a bridge and make Varley loop tests. We will venture the opinion that he has acquired a better grasp of practical mathematics, sometimes called applied mathematics, than 90% of high school graduates. While he would disclaim any knowledge whatever of algebra, he is applying algebraic principles and getting results from their use; something that few high school graduates, either recent or older ones, can do.

Now to refer to the problem of giving articles in plain English that will give the same results as personal instruction.

It can not be done. If it could, the ancient and honored profession of pedagogy would soon find itself without a job. But most of us can not stay under the direction of teachers all of our lives and therefore we must depend upon the printed word and our own study to broaden the education that we obtained from our preceptors.

It is not an easy matter to write an article on electrical testing without the use of certain mathematical symbols because mathematical symbols are such convenient shorthand symbols for expressing facts. In our personal contact with practical men we have had occasion to teach many of them the fundamental fact of electricity known as Ohm's law. Starting with experiments, it was proven that the current always increased in proportion to the voltage applied to the circuit and always decreased in proportion as the resistance was increased. Finally the law was deduced that current is equal to the voltage divided by the resistance. We always required that law to be written out in full as follows:

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$$

Where the law was used in repeated cases we invariably found that the student quickly adopted the abbreviation

$$C = \frac{V}{R}$$

In other words, he adopted the algebraic method of representing the idea as soon as the symbols began to mean something to him even if he had no previous training in algebra.

The same thing happens in the case of the Wheatstone Bridge. We can visualize the process by which Mr. Whitson learned the use of the bridge. His instructor set up the bridge and inserted a coil or some unknown resistance to be measured. He then adjusted the "A" arm to, say 10 ohms and the "B" arms to, say, 100 ohms. The bridge was then balanced by adjusting the "R" arm which, we will say, was found to be 1260 ohms for zero on the galvanometer. He then gave the rule to his student in somewhat this fashion. "The 'A' arm is one-tenth of the 'B' arm so that the coil is one-tenth of the resistance in the 'R' arm or is 126 ohms." This was repeated several times with both known and unknown coils and soon the student came to understand the process and could make the measurements himself. Perhaps he even wrote down the figures

$$\text{Resistance of coils} = \frac{10}{100} \times \text{resistance of "R"}$$

which, after all, means the same thing as the formula found on page 18 of the September issue:

$$X = \frac{A}{B} R$$

In a publication of the character of TELEPHONE ENGINEER which must have material that appeals to the practical man as well has the highly trained technical specialist, it is a difficult matter always to reach every part of its widely varying clientele. One of the difficulties is to get just the kind of article written in plain English that Mr. Whitson desires. Even as experienced a writer for the average telephone man as P. Kerr Higgins finds it necessary to use formulas occasionally. Some of our articles on testing have been without formulas (see July No. p. 38, August No. p. 28), but it is not easy to find men to write them. Mr. Whitson's letter shows that he is not without a considerable amount of ability to express himself in writing. Perhaps he himself can write something that will be helpful to others who describe themselves as "everyday linemen."—Staff Contribution.

TIMELY SUGGESTIONS FOR CABLE FORCES.

Gloves should be worn when handling winch rope or steel cable.

Warn persons to keep away from all ropes which are under strain.

Where the winch rope is so placed as to interfere with traffic, be sure to take all necessary precautions.

Keep your hands away from winch drum while it is in motion.

When winch is running, chauffeur must remain in his place and pay strict attention to signals.

In lifting reels from jacks, use precaution so that jacks will not fall and cause injury.

Good blocking is essential when handling reels of cable. Place yourself where it will be impossible for the reel to fall or roll on you, should anything break.

When it is necessary to leave a cable reel on a street or highway, securely fasten or block it to prevent it from rolling.

Reel lags should never be left lying around or with nails protruding.

When rodding ducts, do not take too long a hold as the rods are liable to bend and break, causing injury to you. If there is a man in next manhole, warn him of the possible

danger of being struck by rods.

When working on a pole where guide blocks or booster hooks have been placed, keep hands and body clear while cable is being pulled. Stand on outside of corner.—"Rochester Telephone Bulletin."

A TELEPHONE LINEMAN

He is the kind of a fellow who will readily grasp your hand
With all the sincerity that a human can command.
He is always ready to do the other fellow a good turn,
Whatever that may be is his chief concern.

The average fellow often wonders where he gets his nerve
As he climbs a fifty footer, just around the curve.
To him it's just a matter of duty, with an added dash of play,
And is just one of the many hazards that comes within the day.

—Frank E. Lawn in Rochester Telephone Bulletin.

CONCERNING KICKERS

A chronic kicker is his own worst enemy. He is the monkey wrench in the machinery of pleasant human relations. And it is a well-known fact that nature always seeks to eliminate that which is disturbing to its well-being.

You can't go around kicking all the time without hurting somebody. It's dangerous.

When you kick, therefore, do it gently, brother. The only way to kick successfully is to know what's wrong, and also to know what can be done to correct it.

If your kick can stand this test, then go ahead and make it.—*The Transmitter.*

ORIENTAL CABLE SPLICING

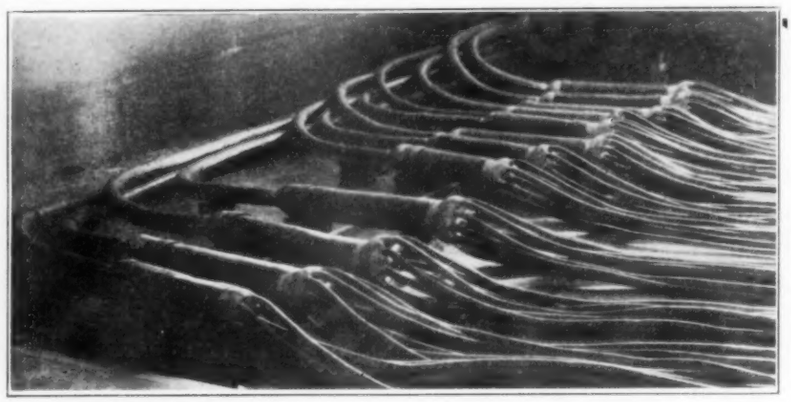
Several years ago, soon after my introduction to the telephone game, I was acting in the capacity of trouble shooter in a small country exchange. When we had cable trouble, which was all too frequent in those days, we called on the District Cableman, who came in on the first train to shoot the bugs. As he carried no helper it fell to my lot to do the "honors" when he was working on our system. I was never overly fond of this assignment because if anything went wrong the blame was always placed on me. Nowadays a joint below the average is due to bad metal as any splicer will tell you, but Heinie always blamed the helper.

When the wind was blowing unusually hard, or for any of the other reasons that splicers' hair turns gray, a splice didn't come out just right, I dodged everything but the hot metal and have been promised the chance to dodge that many times.

I have never forgotten this treatment and after Heinie passed on, if there is no vacancy for a "temperamental splicer" upon aerial work where all good cablemen are supposed to go, and he is obliged to look for a job on the U. G., I hope they don't give him anything more difficult to do than to splice 96, fifty pair cables into 12, four hundreds as shown in the accompanying photographs.

I thought that Heinie could do it, but unless they let him stub them out I would not be his helper without an asbestos unionsuit.

The splicing job shown was done by a Filipino splicer, and is a very neat job, confirming the statement regarding the patience of an oriental. To watch these men work one feels certain that they will surely burn themselves or the sheath, but they seldom do either. When things don't go just right the splicer oblaws something excitedly in Tagolog which I "No savey" but I always think it is about the same line that Heinie used to shout at me in broken English. All which goes to prove that cable splicers do not differ greatly whether in the U. S. A. or on this group of islands which separate the Pacific Ocean from the China Sea. —Ray Blain.



A neat job of Filipino splicing.

Easy to See Why the UNIQUE FURNACE is preferred

PATENTED ARRANGEMENT FOR DISLODGING COIL WITHOUT TEARING DOWN FURNACE
PATENTED SEAMLESS TUBING COIL GENERATOR
IMPROVED ONE PIECE BURNER
HAND HOLD FOR CLEANER ONE TURN CLEANS ORIFICE
AUTOMATIC ORIFICE CLEANER
AUTOMATIC PUMP INSIDE TANK
16 GUAGE STEEL TANK WELDED BOTTOM

Many of the foremost Bell and Independent companies have standardized the Unique Furnace. It melts 50 lbs. of lead in 10 minutes. An automatic orifice cleaner assures continuously efficient operation. It's sturdy and simple.

"UNINTERRUPTED SERVICE"—the result of a "UNIQUE DESIGN and BETTER CONSTRUCTION."

Literature ready—BLOW TORCH and Furnace.

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6" 4-way	6,000 lbs.
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Harmon Harris, Former Automatic Official, Dies at Chicago

Chicago, Ill.—Harmon A. Harris, son of Joseph Harris, one of the leading figures in the history of Automatic Electric, Inc., prior to its acquisition by Gary interests, died at Chicago, January 6, following an illness of several months. Harmon Harris for several years was general manager of the Automatic Electric Co. Following his retirement from the Automatic he devoted himself to his private business interests in Chicago.

Dresser Heads New England Promotions—Howard Retires

Providence, R. I.—George H. Dresser, formerly general manager of the New England T. and T. Co., has been made vice president of that company. Vice President Charles T. Howard retires on January 16, having on that date rounded out 46 years of service in the telephone business. Robert F. Estabrook, formerly traffic manager, succeeds Mr. Dresser as general manager.

Stroud, Okla.—J. W. Walton of Broken Arrow has bought the local telephone exchange from Roy Woolf.

Madison, Wis.—Commonwealth Telephone Co. has bought control of Boone County (Ill.) Rural Telephone Co.

Arcadia, Fla.—Inter-County Telephone and Telegraph Co. is spending $170,000 in rehabilitation and extension of its plant.

St. Louis, Mo.—Southwestern Bell Telephone Co. will spend $33,000,000 in betterment and extension during 1926.

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J. K. Johnston, Telephone Engineer

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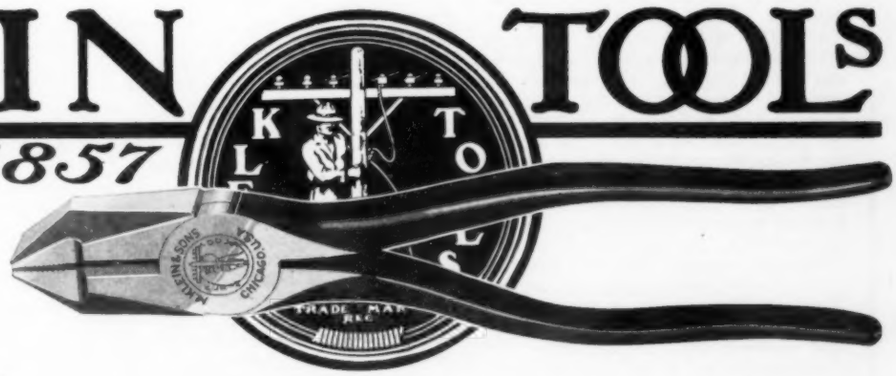
Since 1857



Mathias KLEIN & Sons

Graybar Heir to Western Electric Supply Branch

WHO'S WHO WITH GRAYBAR

ALBERT LINCOLN SALT, President, began his business career in 1881 as a temporary office boy in the New York office of the Western Electric Manufacturing Co. He had finished grammar school, and his connection with business was supposed to last only through the summer after which he was to go to school again. Instead he was promoted within a fortnight to mail clerk, and his parents were prevailed upon to let him work days and study nights. This he did until he reached the age of twenty-five. He advanced to the positions of assistant bookkeeper and cashier, and in 1886 was made shipping ticket clerk and later placed in charge of billing. This work occupied him for several years until, 1892, when he was placed in charge of the retail sales and general clerical work.

During 1895-1899 he was assistant manager of the New York office in charge of telephone sales and purchases, and in 1900 he succeeded to the dual position of assistant telephone sales manager and general purchasing agent. His work as general purchasing agent increased with the development of the Western Electric Company in its supply relationship with the Bell System.

Mr. Salt was placed in charge of the traffic arrangements for the telephone companies in 1898. In 1913 he was elected vice-president of the Western Electric Co., and he has held the position of vice-president in charge of purchases and traffic up to the present time. He has been a director of the Western Electric Co. since 1915. He is also president of the Manufacturers Junction Railway Company of Chicago. Mr. Salt also served as a president of the Telephone Pioneers of America.

FRANK A. KETCHAM, Executive Vice-President, became general sales manager of the Western Electric Co. less than twenty years after he began working for the company as a clerk in its Chicago office. He was born at Saginaw, Michigan, and attended the University of Michigan. He started his business career with the Western Electric Co. at Chicago in 1900 and five years later held the rank of telephone storekeeper. He was advanced to the assistant managership in 1907, and in 1911 was appointed manager. A short time after, he was promoted to the title and duties of Central District Manager. Mr. Ketcham became general sales manager of the Western Electric Co. in 1918, and in 1923 he was appointed general manager of the Supply Department.

GEORGE E. CULLINAN, Vice-President in charge of sales, entered the statistical department of the Western Electric Co. immediately after his graduation from Williams College in 1901. He was acting as chief storekeeper in 1907 when he was transferred to St. Louis. He became assistant manager at St. Louis the following year and in 1909 was promoted to the postion of manager. His next step up was to the rank of western district manager with headquarters in St. Louis, and this was followed by a transfer to Chicago as manager of the Chicago distributing house and central district manager. In January, 1923, Mr. Cullinan came to New York as general sales manager of the Western Electric Supply Department.

LEO M. DUNN has been made a vice-president in charge of merchandising and accounting. He went to work in March, 1886, with the Central District Printing & Telegraph Co. of Pittsburgh, and held his first supervisory job at the age of nineteen, Mr. Dunn started on a long and conspicuous career in the supply distributing business of the Western Electric Co. He held successively a number of important positions. In 1910 he was chief storekeeper of the Pittsburgh distributing house. He became manager at Pittsburgh in 1913, and manager of the Philadelphia house in 1918; the next year he was made assistant eastern district manager. Two years later he was transferred to New York as manager of the New York distributing house and eastern district manager. He became general merchandise manager of the Supply Department in 1923.

ELMER W. SHEPARD, Treasurer of the Graybar Electric Co., has held the position of General Credit Manager of the Western Electric Co. since 1918. Mr. Shepard was born in Winona, Minnesota. His first job was that of office boy for the Chicago & Great Western Railroad. He was employed in the auditing department of the Western Electric Co. at Chicago in 1906, where he remained until 1908, when a transfer and a promotion made him cashier and credit man at the Indianapolis office. He returned to Chicago in 1911 in the credit department, and two years later was advanced to the rank of credit manager at Cleveland. In 1918 came his appointment as general credit manager of the company.

N. R. FRAME, Secretary, began his business career as an office boy for the firm of Hard & Rand, coffee merchants, of New York. Subsequently he worked for a real estate concern, and then determined to study law. He entered the offices of Barber, Watson & Gibboney as clerk and later became managing clerk.

New York City.—The electrical supply business carried on by the Western Electric Co. has been set apart from the telephone manufacturing business and incorporated under the name of Graybar Electric Co. This gives to the supply department a separate identity which is made necessary by its importance as the largest merchandiser of electrical apparatus and related equipment in the world. Since it came into existence in 1869 as the partnership of Gray & Barton, the name which it now resumes in modified form, the supply business has grown steadily until it now serves more than 35,000 customers through fifty-five distributing houses in important cities.

The Western Electric Co. has been both the manufacturing company of the Bell System and a distributor of electrical supplies. Both of these lines of business require specialized organization and specialized management. The rapid expansion of the supply department made an entirely separate corporate identity even more necessary.

Physical separation of the two departments of the Western Electric Co. was carried out in 1923 with the opening of general offices for the supply department in the Pershing Square building, New York. The advent of the Graybar Electric Co. into this field as the successor to the Western Electric Co. to which it was also predecessor therefore involves comparatively few changes.

This is the first instance in business history where a corporation has reverted to its original designation as a basis for its corporate name after such a lapse of time and a period of such tremendous growth. The new name is particularly appropriate since the company is carrying on a business continuing that of the original partnership as it would have developed without the changes caused by the invention of the telephone and the advent of telephone manufacture. The name is that of the oldest electrical manufacturer and distributor still in existence.

Extensive Distribution Facilities

The Graybar Electric Co. has distributing houses in Atlanta, Albany, Baltimore, Birmingham, Boston, Brooklyn, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Davenport, Denver, Detroit, Duluth, Grand Rapids, Houston, Indianapolis, Jacksonville, Kansas City, Los Angeles, Memphis, Milwaukee, Minneapolis, Nashville, Newark, New Haven, New Orleans, New York, Norfolk, Oakland, Omaha,

Philadelphia, Pittsburgh, Portland, Providence, Richmond, Salt Lake City, San Francisco, Savannah, St. Paul, St. Louis, Seattle, Spokane, Syracuse, Tacoma, Youngstown, San Antonio, Miami, Tampa, Harrisburg, Worcester and Toledo.

Sales of the supply department of the Western Electric Co. amounted to $50,000,000 in 1923 and $66,000,000 in 1924.

In 1869, Enos M. Barton, a telegraph operator, obtained four hundred dollars by mortgaging his mother's home to help buy an interest in an electrical shop managed by George Shawk in Cleveland. Electricity was too much of a speculation for Shawk and the ups and downs of business worried him so that in the same year he retired in favor of the partnership of Gray & Barton. Shawk had refused to go into partnership with Elisha Gray, an Oberlin professor, because he was afraid that Gray would "put every man in the place into his darned inventions."

Gray's inventions, nevertheless, became one of the chief assets of Gray & Barton. The cradle of this concern was in Cleveland, but Gen. Anson Stager, then general superintendent of the Western Union Telegraph Co., became financially interested in the firm on condition that it move to Chicago. Late in 1869 Gray & Barton therefore established themselves on LaSalle street, Chicago, near South Water street.

The next year the partnership moved into larger quarters and put in a steam engine to drive its lathes. The force was increased to seventeen men and for the first time Gray & Barton became an important factor in the exceedingly small electrical industry of that day. Two of Gray's inventions were highly successful; a printing telegraph and a needle annunciator. Besides these devices the firm made fire alarm boxes, signal boxes and new models for ambitious inventors.

Gray & Barton reorganized in 1872 and became the Western Electric Manufacturing Co., one-third of the stock being sold to the Western Union Telegraph Co., an arrangement which brought more business and more equipment. All this time the future of the electrical business seemed to be linked with the development of the telegraph, but in 1876 Alexander Graham Bell demonstrated his newly invented telephone, and in 1877 the Western Electric Manufacturing Co. made its first telephone instruments.

The Western Electric Co. succeeded the old company in 1881, and became the following year the manufacturing headquarters for the Bell Telephone system. Keeping pace with the rapid development of telephone service, the company expanded steadily, the growth of its manufacturing facilities being tremendous. Notwithstanding the importance of the telephone department, there was no relaxing of enterprise in the field of electrical supplies.

Gray & Barton, from the very beginning, supplied anything that a customer wanted. As the demand for additional articles increased, so the lines increased. What was sold was not necessarily what the partnership made, but what people wanted to buy. With a demand great enough the firm either began to manufacture the product, or obtained the agency for the product made by someone else.

On this principle the supply business developed consistently, and its service became more valuable to the growing number of customers. Some of the different articles and materials handled by the company during its period of growth later became relatively unimportant, and some proved to be unexpectedly important as time went on.

Catalogs Form Histories

Catalogs published by this branch of the Western Electric Co. over a period of thirty-six years are histories of the development of electricity. The yearbook of the Graybar Electric Co. with more than a thousand pages in 1926 compares with a twenty page catalog of three decades ago which consisted chiefly of remarks about bells and buzzers.

Organized selling actually began in 1893 when Mr. Barton sanctioned the expenditure of a large sum at the World's Fair at Chicago, the first extensive advertising which had been undertaken. A sales department was given special organization and a salesman was put upon the road. This was the beginning of a nation-wide system of distribution and an organization of specialists in every electrical line which is at the service of the customers of today.

The Graybar Electric Co. merchandises a wide variety of supplies through this organization. It will continue the sale of all devices and materials which constituted its business under the Western Electric name. Apparatus such as motors, generators, electric lamps, industrial and other lighting equipment, household appliances, and the like, formerly sold under the Western Electric name, will now be sold under the trade name of Graybar.

The company will continue to market equipment of Western Electric manufacture, such as telephone train dispatching apparatus, inter-communicating telephone systems, lead-covered cable, etc. It will be concerned with radio through its sale of broadcasting apparatus and other radio telephone equipment which the Western Electric Co. may manufacture. Other supplies entering into the Gray & Barton business will be pole line, equipment, schedule material, wire, accessories for electrical contractors and dealers, carrier current systems, etc.

Cincinnati Has Oldest "House."

The oldest distributing house in the Gray & Barton system is that at Cincinnati. In 1883 the Western Electric Co. made an arrangement with Post & Co., a railroad supply house of that city, and this developed into a closer relationship and eventual ownership. A branch of the company was opened in St. Paul in 1899. In 1901 three distributing houses were opened, Philadelphia, St. Louis, and San Francisco. Three more followed in 1903 and also in 1914, Chicago, Denver, Kansas City, Des Moines, Omaha, and Pittsburgh.

Six new houses have been opened during 1925, those at Toledo, Harrisburg, Miami, Tampa, Worcester and San Antonio. The doors of the Worcester house have just been opened.

Aside from the appropriateness of the name due to the fact that Gray & Barton, the partnership, was the predecessor of the Western Electric Co., the Graybar Electric Co. also perpetuates the memory of Elisha Gray and Enos M. Barton, both of whom contributed a great deal to the advancement of the industry. Mr. Barton continued as president of the Western Electric Co. until 1908, and he was chairman of the board until his death in 1916. Professor Gray was the forerunner of the engineering department which played a vital part in the history of the company and the application of electricity.

The Graybar Electric Co. is capitalized at $15,000,000. All of the stock is owned by the Western Electric Co.

The board of directors of the Graybar company consists of A. L. Salt, president; F. A. Ketcham, executive vice-president; George E. Cullinan, vice-president in charge of sales; Leo M. Dunn, vice-president in charge of merchandising and accounting, and the following executives of the Western Electric Co.: Chairman, Charles G. Du Bois, chairman of the board of directors and president; Richard H. Gregory, director and comptroller; Howard A. Halligan, director and vice-president; George C. Pratt, general attorney and secretary, and William P. Sidley, director, vice-president and general counsel.

Hoxsey, Southern Bell Executive, Resigns; Yundt New Treasurer

Atlanta, Ga.—J. M. B. Hoxsey, first vice-president of the Southern Bell and Cumberland telephone companies, has resigned to accept a position with the New York Stock Exchange. Mr. Hoxsey came to Atlanta 23 years ago as auditor for the Southern Bell Telephone Co., having previously been associated with the American Telephone and Telegraph Co. George J. Yundt will succeed him as treasurer of the Southern Bell company.

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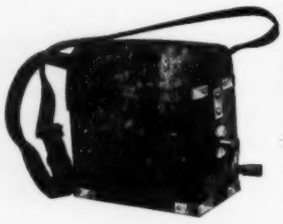
THE "STEWART" TEST SET



Locates those troublesome lightning grounds with ease, even grounded inside wire. Tells which way and how far to trouble, grounds crosses and shorts, thus making it not necessary to visit every house on a line when a line is grounded in the carbons. A two-minute test will often eliminate more than half the houses on the line.

Sent on 10-days trial.

STEWART BROTHERS
MAKERS OF TESTING INSTRUMENTS
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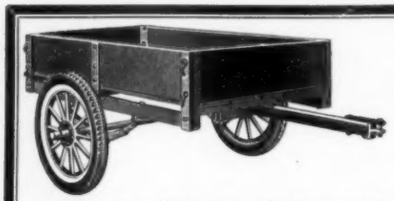

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With sheet of illustrated instructions furnished it is easy to have your local garage or machine shop make up and attach a bracket to any make of automobile to hitch the trailer to.

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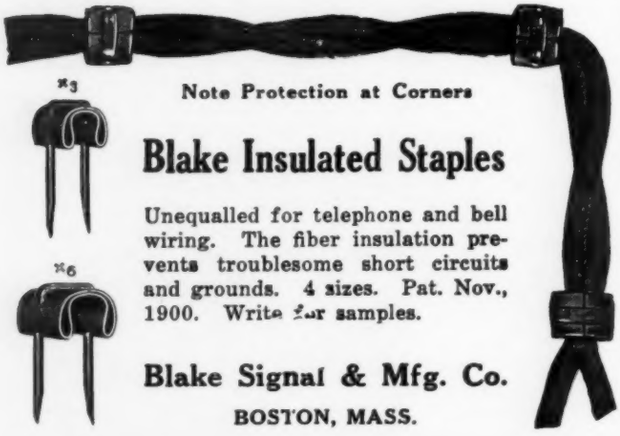

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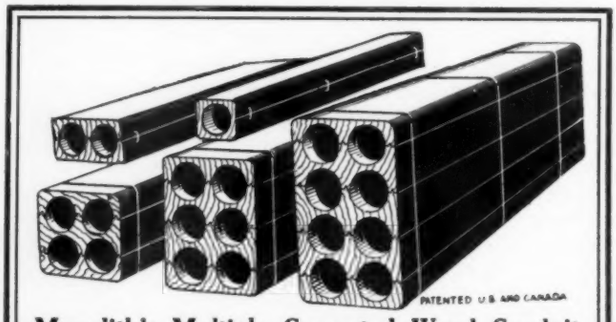

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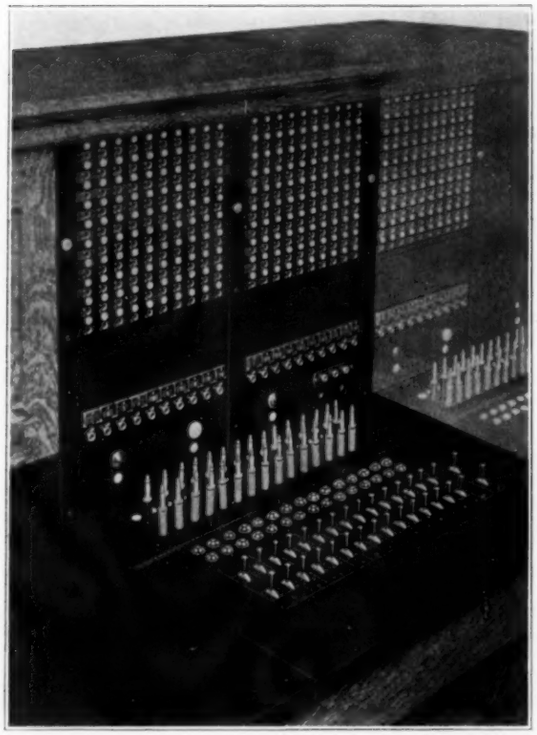
The New Monarch Combination Magneto and Common Battery Switchboard will meet your requirements for either magneto or common battery service during the lifetime of the board. At the time of conversion there is no rebuilding or rewiring to be done. Install this combination board at magneto cost and when you find it necessary to convert it to common battery your investment will be no greater than if the board had been equipped with common battery lines in the first place. Space is provided and arrangements are made for this change, at the time the board is built.

When converting to Common Battery the drops and jacks are replaced with lamps and jacks for the local lines. Two relays are added to the lamp supervisory cord circuits making them universal for both magneto and common battery service. The key shelf with its new style Monarch keys and supervisory signals remains the same for either kind of service. Line cables and relay bays are furnished at the time the conversion is made.



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